A SIMPLE MODEL OF "EXCHANGE MARKET PRESSURE" APPLIED TO THE BRAZILIAN CASE

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The basic theoretical proposition of the monetary approach to the balance of payments is that deficits or surpluses in the overall balance of payments reflect adjustments of the supply of to the demand for money. The few empirical tests of this proposition have used, in general, the small country assumption where the domestic price level is pegged to the world price level via a fixed exchange rate.

Very recently, Lance Girton and Don Roper developed a monetary model to explain what they called "exchange market pressure"--a composite variable made up of the change in foreign reserves of the central bank as a proportion of the supply of base money minus the percent change in the exchange rate. This innovative way of investigation how disequilibrium in the monetary market affects the external imbalance of a certain country presents the advantage of not requiring either the small country assumption or a fixed exchange rate.

Our study presents a very simple version of Girton and Roper's model and the results of its application to the Brazilian case. The simple model states that, under certain simplifying assumptions, a small country's "exchange market pressure"--defined here as the change in net foreign assets of the consolidated banking system as a proportion of the money supply (M1) minus the percent change in the exchannge rate--is explained primarily by the rate of expansion of money created domestically (domestic credit) by either monetary authorities or private banks as a proportion of the money supply (M1) and by the foreign inflation rate.

Brazil was chosen for testing this model because in addition to providing a good example of a post-war managed float system it can be treated as a small, open economy in the sense that it faces given world prices and monetary conditions.

To test the model we used the following regression equation:

$$r+e^* = a_0 + a_1 d + a_2 \dot{p}^* + u$$

where u is an error term, e^* is the negative value of the percent change in the exchange rate, $\dot{p}^*$ is the world inflation rate, and r and d are, respectively, the proportional changes in net foreign assets and in domestic credit as defined above.

This regression equation was estimated for two periods: one from 1955 to 1975 and a shorter sub-period of fourteen years, 1962 to 1975, characterized by less restrictive exchange control and so more consistent with the theoretical model.

The results show a fairly good fit for the 1955-75 period and a very good fit for the 1962-75 period. In both periods the estimated coefficients of d and $\dot{p}^*$ (replaced by the percent change in the

the U.S. wholesale price index) conform to their hypothesized theoretical values of minus unity and plus unity respectively. The model's poorer performance for the entire period resulted in part from greater exchange restrictions prior to 1962. The following conclusions are drawn: a) this simple model does a very good job of explaining Brazilian exchange market pressure in the more recent period; b) the remarkable explanatory power of this model does not rely solely upon the relationship between changes in domestic credit and changes in net foreign assets; c) Brazilian exchange market pressure is independent of the way the monetary authorities try to absorb it. From these conclusions, it follows that for a given foreign inflation rate, variations in the rate of expansion of domestic credit explain most of the variations in net foreign reserves and the exchange rate in Brazil.

CHAPTER I

SUMMARY

The purpose of this study is to test a simpler version of a monetary model developed by Lance Girton and Don Roper which purports to explain a composite variable--the balance of payments as a proportion of the money supply minus the percent change in the exchange rate--called by them the "exchange market pressure."

Brazil was chosen to test the model, in part due to our particular interest in this country, but primarily because it provides a particularly good historical example of a managed floating exchange rate and can also be regarded as a small economy, without a significant effect on the world's monetary conditions. This latter characteristic, as we shall see later on fulfills one crucial assumption of our simple model.

Monetary Institutions, Money Supply, Price Level and Exchange Rate Policies in Brazil

To acquaint the reader with other Brazilian characteristics related to the application of this model, we present in Chapter II an overview of Brazil's financial framework and of the evolution of the exchange rate, money supply and price level.

Brazilian monetary institutions, prior to 1965, were affected by decisions emanating from two entities: the Superintendency of Money and Credit (SUMOC), and the Bank of Brazil. SUMOC, under the direction

of a council composed of various chairmen of departments of the Bank of Brazil and of the finance minister, had the immediate objective of exerting control over the monetary market. For this reason, it was the most important institution setting policies affecting exchange rates. In fact, to study the postwar exchange rate policies in Brazil up to 1964, one has to analyze the various "instructions" issued by SUMOC during the period.

At the end of 1964, following the revolution which established a military government, the Brazilian monetary system was reformulated. The Council of SUMOC was replaced by the National Monetary Council and SUMOC itself was transformed into the Central Bank of Brazil on April 1, 1965. Since then, the Monetary Council and the Central Bank, along with the Bank of Brazil, have formulated the major decisions shaping the monetary system of the country. The National Monetary Council formulates the money and credit policies of the Brazilian government. The Central Bank of Brazil acts in general as the executor of these policies. Among its specific duties established by law are: the emission of currency and coins, control of foreign capital, regulation of the exchange market to obtain stabilization of the exchange rate and equilibrium in the balance of payments, and control over all forms of credit. The Bank of Brazil has been the center of the Brazilian financial system practically since its creation in 1808. Serving as the fiscal agent for the government, it has also been by far the largest commercial bank in the country. More than one-third of the total credit to the private sector comes from the Bank of Brazil. Prior to the establishment of the Central Bank of Brazil it also exerted functions

normally attributed to a Central Bank as was the case of the regulation of the foreign exchange market, Currently, as the financial agent of the National Monetary Council the Bank of Brazil is characterized essentially as an instrument for the execution of credit and financial policies of the federal government.

Regarding the evolution of the money supply and of the price index, the relevant feature for our empirical study is that over the long run the correlation between the rate of inflation and the rate of growth of the money supply is very high. This can be seen in Figure 1. If it is assumed that the monetary market adjusts properly, the relevance of such a high correlation is that, at least in a pragmatic way, one can say that the rate of inflation accounts for most of the rate of growth of the demand for money. This is very important since the model we tested, using data for Brazil, as we shall see, embodies such an asusmption, although clearly, movements in the supply of money cause, in part, variations in the inflation rate.

In terms of the exchange rate system, Brazil has experienced several variations since the end of World War II. After a short period of free imports under an overvalued fixed exchange rate which resulted in large deficits in the balance of payments, rigid exchange controls, characterized mainly by restriction on imports, were implanted in 1948 and lasted until 1953. During this period any import was subject to receipt of a license granted by the Bank of Brazil. Despite rising prices in Brazil, the 1948 official rate of Cr$18.72 per U.S. dollar prevailed until January 1953. From February to September 1953, except for those imports of national interest which continued to be effected at privileged official rates, imports were

purchased at a free market rate. From October 1953 to 1961 the Brazilian monetary authorities adopted a complex system of multiple rates, by which imports had to be paid for at the official rate plus a premium determined in exchange auctions carried out by the monetary authorities for the different currencies, almost every week. Until mid-August of 1957 imports were grouped into five categories; the most essential being category I and the least essential in category V. A minimum bid for each category was established by the monetary authorities. The less essential the category, the greater was the minimum bid. To simplify things, in mid-August of 1957 the five categories were consolidated into two: the general and the special categories. From March to December of 1961 another move of the Brazilian monetary authorities toward a free market took place. Such a move however did not succeed so that by January of 1962 the exchange rate was again being determined by the monetary authorities.

Roughly speaking, from 1962 to August of 1968, Brazil followed a fixed exchange rate in line with the Bretton Woods scheme. Large devaluations occurred, however, from time to time. In view of the high rates of inflation that took place in that period, principally during 1962 through 1964, devaluations were in general anticipated. This brought consequent movements of speculative capital with substantial outflows and inflows of foreign capital prior to and after large devaluations.

From August 1968 until now (November 1977) the Brazilian monetary authorities have been employing a system of devaluing the cruzeiro more frequently and in smaller amounts. From the implementation of this

system through December 1976 there were 80 devaluations averaging 1.5 percent each. This can be seen in Table 12 in the Appendix. This system, called "mini-devaluation" in Brazil, appears to have been adopted primarily to avoid large movements of speculative capital and to increase exports.

Taking into account the percent change in the average import exchange rate and the difference between the percent changes in the wholesale price indexes of Brazil and U.S.A., one finds that after 1961 these variables have followed the predictions of the purchasing power parity theory at least in a relative sense. This evidence is found in Figure 3 of Chapter II.

The Theoretical Framework of the Study

In Chapter III, after a brief reference to more traditional approaches to analyzing the effect of a devaluation upon the balance of payments--the elasticity and the absorption approaches--we present the basic theoretical arguments on which rest the monetaristic conclusions about the sources of an external imbalance and the role of the exchange rate in bringing about an equilibrium between exchange earnings and payments. Then we present a summary of the model developed by Girton and Roper as a different and innovative way of seeing how monetary pheonomena affect the external sector of a country. This approach is the basis of our study.

The essence of the monetary approach to the balance of payments is in the proposition that deficit or surplus in the overall balance of payments results necessarily from disequilibrium in the monetary market. Therefore, to establish a systematic way of interpreting

the monetaristic arguments one first has to assume the existence of a stable monetary market and then look at the components of the money supply. To fulfill this latter task let us consider the consolidated balance sheet of the monetary authorities and commercial banks; that is, the balance sheet of the whole monetary system of a certain country. Excluding irrelevant figures such as the cpaital account, we can summarize that balance sheet as follows: the assets side with net foreign assets or net international reserves (R) and domestic assets (A), made up of claims on government such as government securities and claims on private sector following the IMF's terminology; the liabilities side with the money supply (M), defined as currency held by the public plus demand deposits and other liabilities or non-monetary liabilities (O). The identity between assets and liabilities may be written:

$$(1) \quad M \equiv R + D$$

where D, equal to A minus O, is the commonly called domestic credit or domestically created money.

The relevance of identity (1) is that it shows clearly that the domestic money supply comes from two different sources: the available net stock of international reserves (R) and the money created domestically by either monetary authorities or private banks. If the change in domestic credit (D) is independent of the result of the balance of payments, that is, if the change in (D) is independent of the changes in net international reserves (R), it directly follows that the increase or decrease in net international reserves does affect the domestic money supply. In this way the basis for accepting the monetaristic view of the balance of payments is established. Since R measures foreign assets or international reserves in domestic currency, let us say that it equals ER* where E is the exchange rate--the price in

domestic currency of the foreign currency--, and R* is international reserves measured in foreign currency. Let us say in addition that L is a stable demand-for-money function, whose arguments are--for example--the price level, income, and interest rates.

From the assumption of a stable monetary market, meaning that discrepancies between money supply and money demand tend always to disappear, we may write:

$$(2) \quad ER^* + D = L$$

which expresses the equilibrium between money supply and money demand.

Suppose, now, that for some reason the money supply (M) exceeds the corresponding demand given a fixed exchange rate. Independently of the way in which this could affect the money demand--probably via movements of the domestic price level and interest rates--it is expected that more foreign exchange will be purchased to make payments abroad, thus worsening the balance of payments, decreasing the country's net foreign assets (R) and consequently reducing the domestic money supply. Such a process will continue until the domestic money supply equals money demand.

Given that domestic monetary policy determines changes in domestic credit (D), it also follows from (2)--using the same reasoning--that although an expansionary monetary policy, under a fixed exchange rate, can initially increase the money supply by an equivalent amount of the increase in (D), after the consequent adjustment takes place with loss of foreign reserves, it turns out that monetary policy can not fully control the money supply. The degree of control will depend, of course, on the ability of the country to affect the demand for money through an increase in domestic credit. If none of the variables affecting the money demand are ceteris paribus, affected by

an increase in (D) the country will have no control at all of the money supply. Given a fixed exchange rate, an increase in domestic credit should be totally nullified by a decrease in net foreign assests of the same amount. This is particularly so in the case of an open small economy with the domestic price level and interest rate pegged to those of the world. On this inability to control the domestic money supply rests therefore the monetaristic argument that monetary policy and so the control of domestic credit determines the country's net flows of international reserves and consequently its balance of payments.

Regarding the role of the exchange rate the monetarists argue that a devaluation improves the balance of payments because it raises domestic prices, increasing in this way the demand for money. The improvement in the balance of payments does nor result from a change in relative prices. In fact, if domestic credit is maintained constant and devaluation does imply an increase in the demand for money, the resultant excess demand should finally raise the money supply via an increase in net foreign assets in terms of domestic currency. The only doubt is whether holdings of foreign assets in terms of foreign currency also increases. If one considers that R is usually a small portion of M and devaluation noticeably increases the demand for money L, there is no doubt that it must imply an improvement in R* and so in the balance of payments in foreign currency. Suppose that a devaluation of 10 percent leads to an increase in the demand for money of the same proportion. If R were to rise only due to the increase in the exchange rate (devaluation), it should evidently

rise also by 10 percent. However, since L is larger than R, and D is supposed to remain unchanged, the only way by which the monetary market could reach its equilibrium again is by increasing R in a proportion greater than that of the money demand. So when the exchange rate-elasticity of the demand for money is unity, under the monetaristic point of view, a devaluation must always improve the balance of payments in foreign currency. In fact, as we show in Chapter III, whenever the exchange rate-elasticity of the demand for money exceeds the proportion of net foreign assets in domestic currency (R) to the money supply (M), a devaluation must improve the balance of payments in foreign currency.

These are the theoretical foundations embodied in the monetary approach to the balance of payments. For empirical purposes one has, obviously, to specify the demand for money and make the necessary arrangements in order to obtain a suitable regression equation for testing the model. A complete discussion of this monetaristic view of the balance of payments can be found in Johnson (1972) where he begins with a simple model for a single small country, which is growing over time, under a fixed exchange rate and gradually analyzes more complex situations taking into account the monetary equilibrium for the whole world.

Due perhaps to its incontestable theoretical foundations and also to its simplicity, the interest in the monetary approach to the balance of payments has been growing. The relevant literature is augmented each year. Empirical studies however are few and most of those available are related to the application of models for a single small country

growing over time with the price level and interest rate pegged to those of the world, under a fixed exchange rate system. The reasons are simple: the necessity to link the exchange rate with the demand for money and to avoid simultaneity problems.

More recently, Lance Girton and Don Roper presented a model which by being less restrictive offers opportunities for testing the monetaristic view of the balance of payments. It does not require either the small country assumption or a fixed exchange rate.

Starting with the assumptions of monetary equilibrium for the base money of two countries, c and u--the latter with the ability of sterilizing completely its net flows of international reserves and so having full control of its money supply--and establishing the monetary interaction between both countries, under certain simplifying assumptions, they derived the following regression equation:

$$(3) \qquad r_c + e_{cu} = - \emptyset_c d_c + \emptyset_u h_u + \beta_c y_c - \beta_u y_u + v$$

where v is an error term and other symbols are as follows:

r_c = change in net foreign assets of the central bank in country c as a proportion of its base money;

e_{cu} = rate of appreciation of currency c in terms of currency u;

d_c = change in domestic credit of the central bank in country c as a proportion of its base money;

h_u = rate of growth of country u's base money;

y_c = rate of growth of country c's real income;

y_u = rate of growth of country u's real income.

The coefficients β_c and β_u are respectively the income-elasticities of the demand for base money in country c and in country u. Under the hypotheses they used to derive (3) the true value of $\emptyset_c$ should be no greater than unity and its estimated value would provide an indication of whether country c has an independent monetary policy under a fixed exchange rate regime. An estimated $\emptyset_c$ close to one would indicate that the country has limited monetary independence. That is, ceteris paribus, an increase in the rate of expansion of domestic credit of the central bank would not affect the rate of growth of the base money. The relevance of country u having the ability to sterilize surpluses or deficits in its balance of payments is that in this case h_u must be independent of r_c or e_{cu} and consequently any reason to claim y_u is dependent of these variables would be eliminated. As long as sterilization does not take place in country c and the right-hand side variables are independent of the left-hand variables, equation (3) should explain the composite variable $r_c + e_{cu}$, which they called country c's "exchange market pressure." Hence equation (3) presents the following features:

a) it provides a direct link between the "exchange market pressure" in country c and monetary conditions abroad;

b) it permits a test of whether country c has an independent monetary policy;

c) it is applicable to any exchange rate system, provided that the "exchange market pressure" $r_c + e_{cu}$ is independent of its composition;

d) it does not require that country c present the characteristics of a small country.

Girton and Roper estimated equation (3) for the Canadian case vis-à-vis the U.S. using data from the 1952-1974 period, embracing years of fixed and years of floating exchange rates. Except for the fact that the estimated income-elasticities of the demands for base money were significantly greater than one, the results appeared excellent. All estimated coefficients had the expected signs and were significantly different from zero at a 5 percent confidence level.

The merit of this model however does not lie in these empirical results. Its virtue comes from the innovative approach that Girton and Roper gave to the monetary phenomenon by attempting to explain the composite variable $r_c + e_{cu}$, or the "exchange market pressure" as they call it.

In Chapter IV, we present a very simple model of this "exchange market pressure" for a small open economy having its price level pegged to that of the world through the purchasing power parity theory, and a demand for money following the classical quantity theory of money so that the basic relationship used are:

$$R + D = kpy, \quad \text{monetary equilibrium} \tag{4}$$

$$E = p/p^*, \quad \text{purchasing power parity} \tag{5}$$

where R = net foreign assets of the monetary system (monetary authorities plus commercial banks);

D = domestic credit of the monetary system;

k = constant;

p = doemstic price level;

y = permanent real income associated with long run full employment;

E = exchange rate defined as the price of the foreign currency in domestic currency;

P^* = foreign price level.

Differentiating (4) and (5) with respect to time expressing the results in rates of growth and further assuming that y grows at a constant rate, after making the necessary manipulations, we derived the following regression equation:

$$(6) \qquad r + e^* = \alpha_0 + \alpha_1 d + \alpha_2 \dot{p}^* + u$$

where u is an error term with the usual properties required for ordinary least squares, and, by approximation:

$r = \frac{\Delta R}{R + D}$, change in net foreign assets as a proportion of the money supply MI;

$e^* = -\frac{\Delta E}{E}$, the negative of the percent change in the exchange rate;

$d = \frac{\Delta D}{R + D}$, change in domestic credit as a proportion of the money supply MI;

$\dot{p}^* = \frac{\Delta p^*}{p^*}$, rate of inflation of the foreign price level.

Evidently the regression equation (5) is not appropriate for testing the question of monetary independence. Monetary dependency was already assumed so that the model predicts α_1 to be minus unity. Except for this and for the fact that it is restricted to the small country case, equation (6) presents all the features of Girton and Roper's model since:

a) the foreign inflation rate $\dot{p}^*$ provides the link between the domestic "exchange market pressure" and monetary conditions abroad;

b) it stresses that, other things being equal, an expansion of domestic credit by either the monetary authorities or commercial banks will create an adverse pressure forcing therefore a depreciation of the domestic currency, loss of foreign assets or a combination of both;

c) it can be applicable independently of the way the monetary authorities are handling the exchange rate, provided that the "exchange market pressure," $r + e^*$, is independent of its composition as the model predicts.

In compensation for being unable to serve for testing the monetary independence question and for being restricted to the small country case, equation (6) presents an advantage: the possibility of multicollinearity and measurement error problems is much reduced, which makes it more suitable for small economies, where, very often, data are less accurate than for large industrial countries.

Empirical Results

Regression equation (6) was applied to the Brazilian case for the 1955-1975 and 1962-1976 periods using annual data and the Cochrane-Orcutt iterative technique to adjust for serial correlation. The percent change in the U.S. wholesale price index was used as the foreign inflation rate. The choice of the two periods was based on the fact that 1954 and mainly 1961 marked the beginning of less restrictive exchange control in Brazil bringing consequently more openness to its economy. The rigid exchange control that prevailed from 1948 to 1953 is inconsistent with the open economy assumption so that any conclusion drawn from results including annual data prior to 1954 should be discounted.

The estimated regression equation for 1955-1975 period was:

$$(7) \qquad r + e^* = \underset{(1.258)}{0.138} - \underset{(-5.406)}{1.125d} + \underset{(1.312)}{1.322\hat{p}^*}$$

where the numbers in parenthesis stand for t-values. The F-statistic, equal to 17.68, indicates that at 1 percent confidence level the overall estimated equation (7) significantly explains variations in Brazilian "exchange market pressure." The coefficient of determination, although not unusually high--equal to 0.68--indicates reasonable explanatory power. The estimated coefficients of domestic credit creation as a proportion of the money supply (d) and of the foreign inflation rate $\hat{p}^*$ conform to values predicted by the model. That is, at a 5 percent significance level one would not reject the hypotheses that they are equal to minus unity and unity, respectively. However, at the same significance level one would not reject the null hypothesis that the estimated coefficient of the foreign inflation rate is equal to zero.

The estimated regression equation for the 1962-1975 period presents a much better fit. The results are:

$$(8) \qquad r + e^* = \underset{(3.088)}{0.177} - \underset{(-11.429)}{1.195d} + \underset{(2.594)}{1.247\dot{p}^*}$$

which indicates, from a statistical point of view a total conformation to the model's prediction. At a 5 percent confidence level one can not reject the null hypotheses that α_1 and α_2 are respectively equal to minus one and to one. Moreover, at the same confidence level one can not say that the referred coefficients are equal to zero. Other significant results: a) the F-statistic, equal to 57.30, shows that the estimated equation (8) is highly significant in the explanation of variations in the Brazilian "exchange market pressure"; b) the coefficient of determination, equal to 0.92, shows that most of the variation in the composite dependent variable is explained; and c) the Durbin-Watson coefficient is close to two--equal to 2.11--suggesting that coefficient confidence intervals are not underestimated because of autocorrelation.

The principal reasons the model loses explanatory power when the sample is extended back to 1955 could be two: the first--the most plausible--is that, very likely, during 1955-1961 the Brazilian economy did not present the necessary requirements implicit in the regression equation (6). Its degree of openness was perhaps not significant enough to conform closely with the assumptions implicit in (6). In fact, looking at Figure 3 in Chapter II one will see that during 1955-1961 there is no significant evidence that the purchasing power parity theory is applicable in a dynamic sense, as is assumed

in the model. The second possible reason is that during 1955-1961, mainly up to 1957, a complex system of multiple exchange rates was in force in Brazil so that to figure out an appropriate measure of the effective average exchange rate is difficult. So the average exchange rate used for the period may be too inaccurate to be helpful.

To explore the possibility that the explanatory power of the model for the 1962-1975 period could be attributable to the relationship between the rate of expansion of domestic credit and net flows of foreign assets, we estimated equation (6) with r alone as the dependent variable. The results were poor. The F-statistic--equal to 4.67--indicated that the estimated equation did not explain variations in r significantly at a 1 percent confidence level and the coefficient of determination was low, equal to 0.48.

In order to respond to the question of whether the Brazilian "exchange market pressure" was independent of the way the monetary authorities were trying to absorb it we ran the regression equation (6) including an additional regressor k--defined in Chapter V--measuring the relative composition of the dependent variable $r + e^*$. The results indicated that k explained nothing. The inclusion of k brought no noticeable improvement to the coefficient of determination and morevoer, the very low t-value of its estimated coefficient would not allow one to reject the null hypothesis that this coefficient is equal to zero.

In short, from the empirical tests that we carried out, the following conclusions can be drawn:

a) the regression equation (6) has considerable explanatory power with respect to variations in the Brazilian "exchange

market pressure"--the balance of payments as a proportion of money supply minus the percent change in the exchange rate defined as NCrS/U.S.$--for the 1962-1975 period;

b) the Brazilian "exchange market pressure" does not depend on its composition. Stated differently, whether the Brazilian monetary authorities devalue the cruzeiro by large or small amounts does not affect the country's "exchange market pressure";

c) the explanatory power of the model does not rely on the relationship between domestic credit creation--by either monetary authorities or commercial banks--and net flows of foreign assets.

In view of these conclusions it is evident that given the foreign inflation rate the control of domestic credit creation is the key to the control of Brazil's net flows of foreign assets if the rate of devaluation of the cruzeiro is fixed.

CHAPTER II

EVOLUTION OF MONETARY VARIABLES IN BRAZIL

This chapter, intended for the reader unacquainted with Brazilian institutions, describes the evolution of monetary variables[1] in Brazil since 1946. We present first a summary of the financial framework with emphasis on monetary institutions. Then we take a brief look at changes in the money supply and the domestic price level and finally we discuss the principal exchange rate policies used in Brazil since the end of World War II.

The Institutional Framework

Before 1965 the Brazilian financial system consisted of i) the Superintendency of Money and Credit; ii) the Bank of Brazil; iii) the National Bank for Economic Development; and iv) other financial institutions.

The Superintendency of Money and Credit (SUMOC), created in February of 1945 and directly subordinate to the minister of finance, had the immediate objectives of exerting control over the monetary market and of preparing the organization of the Central Bank of Brazil.

Although the control of exchange was executed by the Bank of Brazil through its foreign exchange department, the most important institution setting exchange rate policies in the country was indeed SUMOC. Under the direction of a Council composed of various chairmen of departments

of the Bank of Brazil and of the finance minister (who presided over it), SUMOC established exchange rate policy and acted simultaneously as an advisory council.[2]

At the end of December, 1964, the Council of SUMOC was replaced by the National Monetary Council and SUMOC itself became the Central Bank of Brazil,[3] and incorporated the functions related to exchange control and to the control previously carried out by the Bank of Brazil, of rediscounts and reserve requirements of the commercial banks.

Since then the National Financial System has consisted of: i) the National Monetary Council; ii) the Central Bank of Brazil; iii) the Bank of Brazil; iv) the National Development Bank; and v) other financial institutions, both public and private.[4]

National Monetary Council

The National Monetary Council, which formulates money and credit policies, is composed of the following members: the finance minister (its president), the presidents of the Bank of Brazil and the National Development Bank, and 6 other members chosen from Brazilians with backgrounds in economic and financial matters. These 6 members are appointed for 6 years by the President of the Republic after approval by the Federal Senate. The National Monetary Council is assisted by 4 consultive commissions representing banking, the capital market, rural credit and industrial credit. Its decisions are made public via Resolutions of the Central Bank.

By law the National Monetary Council's policy has the following objectives:

i) to adapt the volume of the means of payment to the real needs of the national economy;

ii) to regulate the domestic value of the currency and thereby prevent or correct inflationary or deflationary trends of domestic or foreign origin as well as economic depressions and other disequilibria resulting from temporary phenomena;

iii) to regulate the external value of the currency and the equilibrium of the balance of payments of the country taking into account the optimal utilization of foreign exchange resources;

iv) to orient the allocation of the resources of financial institutions, whether public or private, creating favorable conditions for the harmonious development of the national economy within the different regions of the country;

v) to perfect financial institutions and instruments in order to achieve greater efficiency in the system of payments and the mobilization of resources;

vi) to promote the liquidity and solvency of financial institutions; and finally,

vii) to coordinate internal and external monetary, credit, budget, fiscal and public debt policies.

Central Bank

Created to replace the Superintendency of Money and Credit (SUMOC), the Central Bank of Brazil is administered by a board of 4 Directors one of whom is the President, chosen by the National Monetary Council among its 6 members appointed for 6-year terms.

In addition to executing the norms issued by the National Monetary Council, the Central Bank emits currency and coins, effects loan and

rediscount operations, executes the operations determining the money supply, receives compulsory deposits, acts as the depository for official gold and foreign currency reserves, controls foreign capital, buys and sells federal public obligations, regulates the functioning of the exchange market in order to stabilize the exchange rate and to establish equilibrium in the balance of payments; and exercises control over all forms of credit.

In compliance with the National Monetary Council and legal provisions, the Central Bank may install agencies in the various regions of the country to achieve administrative decentralization for purposes of distribution and collection of currency.[5] However, the Central Bank operates exclusively with financial institutions; banking operations of whatever nature with other juridical persons (public or private), except those expressly authorized in law, are prohibited.

Bank of Brazil

The Bank of Brazil, created in 1808, is the oldest bank in the country. It is said that the history of the banking system of the country is the history of the Bank of Brazil itself. In fact at least up to 1964, to understand the Brazilian financial system one has to study essentially the functions of the Bank of Brazil.

Serving as the fiscal agent for the government, the Bank of Brazil is also, by far, the largest commercial bank in the country, having several hundred branches providing more than one-third of the total credit to the private sector. It should be stressed that although competing with the private banks, the Bank of Brazil is not subject to reserve requirements so that its loans to the private sector are restricted only by the National Monetary Council, which imposes overall credit ceilings.[6]

Prior to the establishment of the Central Bank on April 1, 1965, the Bank of Brazil exerted many of the functions of a central bank. Regulations of the foreign exchange market for instance was carried out by its foreign exchange department and control of the rediscounts and reserve requirements of the commercial banks by its department of rediscount.[7]

As the financial agent of the National Treasury under the supervision of the National Monetary Council, the Bank of Brazil is now essentially an instrument for the execution of the credit and financial policy of the Federal Government. Its president is appointed by the President of the Republic with previous approval of the Federal Senate.

Besides serving as a commercial bank, it has as its principal responsibilities the following: to receive the credit of the National Treasury the amounts accruing from the collection of Federal taxes or incomes; to effect the payments and transfers necessary to the execution of the Federal Budget in accordance with authorization transmitted to it by the Finance Minister; to acquire and finance inventories of exportable production; to administer the policy of minimum prices for agropastoral products; to act as receiving and disbursing agent abroad; to service the consolidated public debt; to serve as clearing house for checks and other paper; to effect, on its own account and for the account of the Central Bank in compliance with the National Monetary Council, the purchase and sale of foreign currency; to execute foreign trade policy; to supplement the activity of the banking network in the financing of imports and exports.

National Development Bank

Created in 1952, the National Development Bank has the fundamental objective of financing infra-structural investments considered essential to the growth of the Brazilian economy. Its field of activity includes financing re-equipping and expansion of the railway system, re-equipping and expansion of harbor installations and navigation system, construction and expansion of electric power systems, installation and expansion of basic industries, construction and expansion of meat-packing plants, and the development of agricultural inclucing rural electrification through the installation of small water falls and other means.

The resources of the National Development Bank come from the following major categories: i) its own capital and reserves; ii) funds which are freely administered by the Bank, at its own discretion without being part of its assets since they are returnable according to law; iii) special resources including loans in foreign currency obtained by the Bank to be subsequently transferred to Brazilian corporations and resources of some development funds, which have been created since 1964 by the Federal Government to channel loans and grants to the private sector for specific purposes.[8]

The National Development Bank has an Administrative Council composed of 6 members, 2 of whom are replaced each year, and a Board of Directors also composed of 6 members: the President of the Bank, the Director-Superintendent (serving a term of 5 years) and 4 Directors with 4-year terms. The President of the Bank is the chairman of the Administrative Council.

Other Financial Institutions

Other Financial Institutions comprehend all those other public or private juridical persons having as their principal or accessory activity the collection, intermediation or application of their own or third parties' financial resources in the form of national or foreign currency or which serve as the custodian of the property of third parties. The law considers as equivalents of financial institutions those individuals exercising any of these activities on either a permanent or sporadic basis.

Besides to official and private banking establishments, credit, financial and investment companies, saving institutions, credit cooperatives and credit departments of other cooperatives, the provisions of Law 4595 of December 31, 1964, which regulates banking, are applicable also to stock markets, insurance and capitalization companies, entities effecting the distribution of prizes in the form of real property, merchandize or money through lottery or other means and those physical or juridical persons that exercise on their own account or for third parties activities related to the purchase and sale of stocks and other paper in the financial or capital markets or perform services akin to those performed by financial institutions.

Financial institutions can function in Brazil only with previous authorization of the Central Bank, or by Presidential decree if foreign. Federal public financial institutions have their activities, capacity and operations regulated by the National Monetary Council. The National Housing Bank for example--which is the principal instrument for the execution of the Federal Government housing policy and, together with real property credit societies, is integrated into the national financial system--works under the orientation, authorization, coordination and control of the National Monetary Council and the Central Bank.

Except for credit cooperatives, private financial institutions must be organized as corporations with their capital represented by nominative shares. They must preferably apply no less than 50 percent of the public deposits they receive in their respective states or territories. With the exception of investment institutions, private financial institutions may participate in the capital of other entities only with previous authorization expressly granted by the Central Bank. Other restrictions on private financial institutions are: prohibition of issuing bonds, debentures, and acquiring real property not destined for their own use, except when received in liquidation of loans of difficult or dubious payment, in which case the property should be sold within 1 year of the date of receipt.

Evolution of the Money Supply and Price Level

Inflation has long been present in Brazil. Only after World War II, however, did the Brazilian inflationary process begin to accelerate. Figure 1 shows the acceleration of the rise of the general price index culminating with an inflation rate of 90 percent in 1964. After 1964 follows a period of decreasing rate until 1973, after which year the figures suggest a possible return of the acceleration of inflation.

Whatever the cause of these high rates of inflation, there exists an evident correlation between the rate of expansion of the money supply and the rate of change of the general price index. As can be seen in Table 1 and the correspondent Figure 1, the acceleration of inflation in the postwar period follows an acceleration in the rate of expansion of the money supply. Also, when the rate of expansion of the money supply begins to decline after 1964, the rate of inflation follows it. The simple correlation between annual rates of change in the stock of money and annual rates of inflation is 0.85 for the years 1947 through 1976.

Table 1

EVOLUTION OF THE MONEY SUPPLY AND OF THE GENERAL PRICE LEVEL, 1946-1976

Years	Money Supply		General Price Index 1965/67 = 100	
	Cr$ (Millions)	% Change	Absolute Values	% Change
1946	42.0	-	.765	-
1947	43.8	4.3	.856	11.9
1948	43.9	0.2	.916	7.0
1949	50.3	14.6	.981	7.1
1950	61.4	22.1	1.09	11.1
1951	77.0	25.4	1.27	16.5
1952	88.3	14.7	1.42	11.8
1953	104.2	18.0	1.63	14.8
1954	128.4	23.2	2.07	27.0
1955	152.9	19.1	2.41	16.4
1956	183.8	20.2	2.89	19.9
1957	225.5	22.7	3.30	14.2
1958	301.6	33.7	3.73	13.0
1959	385.3	27.8	5.14	37.8
1960	540.3	40.2	6.64	29.2
1961	781.6	44.7	9.10	37.0
1962	1213.5	55.3	13.8	51.0
1963	1926.8	58.8	24.2	75.4
1964	3560.6	84.8	46.1	90.5
1965	6533.3	83.5	72.3	56.8
1966	8842.7	35.3	99.8	38.0
1967	12098.8	36.8	128	28.3
1968	17086.0	41.2	159	24.2
1969	22598.0	32.3	192	20.8
1970	29054.2	28.6	230	19.8
1971	37904.2	30.5	277	20.4
1972	49653.2	31.0	324	17.0
1973	72953.6	46.9	373	15.1
1974	100926.8	38.3	480	28.7
1975	134245.3	33.0	613	21.7
1976	188872.3	40.7	866	41.3

Source: Conjuntura Econômica, April 1977.

Note: The money supply refers to the arithmetic average of the stocks on the last day of each month, as reported in Table 9 in the Appendix.

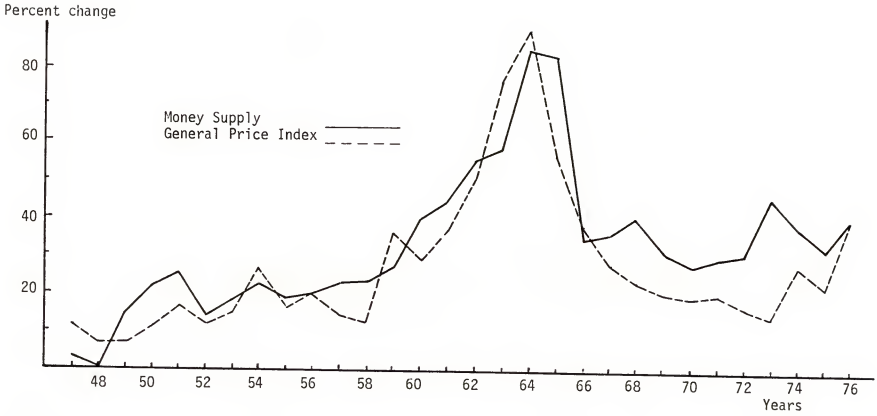

Figure 1

Money Supply and General Price Index. Percentage Variations, 1947-1976.

The Evolution of the Exchange Rate

During much of the period under consideration Brazil has had multiple exchange rates. There has been a spread between import and export rates due to the use of premiums, charges, and auctions so that a complete discussion would require analysis of both import and export policies. In what follows, we show briefly how the Brazilian monetary authorities have conducted exchange rate policies after World War II, mainly those related to imports.[9]

The 1946-1968 Period

Emerging from World War II with substantial foreign reserves but short of machinery and equipment, Brazil was by the end of 1947 already experiencing a rapid depletion of foreign reserves. The reasons are that in addition to having an insatisfied demand for foreign products, after the war Brazil maintained a "free" market for foreign exchange with an overvalued fixed import exchange rate of Cr$18.72 per U.S. dollar. A tax on remittances was imposed on January 1, 1948, at a level of 5 percent and a more significant step to avoid further deterioration of the balance of payments was taken in the following month through implementation of a system of exchange controls by which foreign transactions were subject to licenses controlled by the Bank of Brazil.

The main goal of this system of licenses was to control imports. Only imports of great priority such as cement, medicine, petroleum, some foodstuffs and purchases of the government were exempt from such licenses. Requests for licenses for imports from strong currency areas were frequently examined to see whether the same product could be obtained from weak currency areas.[10]

Despite this direct exchange control the deficit trend of the balance of payments continued to worsen. while on the one hand a drive for increased productivity and plant expansion associated with the long-suppressed demand for new equipment was facing rising world prices, on the other domestic inflation brought about a steady rise in production costs causing export products to be priced out of world markets. In addition, in the early 1950's fears that the war in Korea could spread induced heavy imports of essential items.

This system of licenses did not succeed in bringing about a balance between exchange earnings and payments. Its administration turned out to be vulnerable to bribery and corruption. In short, using Huddle's words (1964, p. 40) it "proved inefficient, difficult to administer, and disruptive to commerce and planning under conditions of domestic inflation and a fixed exchange rate which became increasingly overvalued."

Believing that the system of licenses had failed to meet its objectives, in February 1953 the Brazilian monetary authorities adopted a free market approach,[11] through which imports were carried out only until September of the same year and transfers of funds until September 1961. Thus the free market system turned out to be just a transitory one.

In October 1953 Brazil shifted to a new and complex exchange rate policy by which the allocation of available foreign exchange was effected via a system of auctions.[12] This new system, which in its essence had been successfully employed by Raul Prebish in Argentina during the 1930's, required all exports proceeds to be sold to the monetary authorities at the par rate plus an export premium varying by product.[13]

As for imports, those related to newspring, wheat, coal, petroleum products, and some machinery, enjoyed favored non-fluctuating rates which

were revised upward, however, from time to time. Remaining imports were classified into 5 categories and purchased at fluctuating rates under an auction certificate system by which the available supply of foreign exchange was sold by the monetary authorities at the periodic (usually weekly) auctions for the various currencies.[14] A minimum bid, also revised upward from time to time, was required for each category with higher minimum bids required for low priority categories.

In short, in order to obtain foreign exchange, an importer, in addition to buying the exchange at the official rate, had to pay an exchange tax and surrender an auction certificate in the amount of the exchange required so that the effective rate for any import was, therefore, the official exchange rate plus an exchange tax plus the price paid for the auction certificate.[15]

Table 2 reports some quotations of the U.S. dollar within the auction certificate system.

Table 2

QUOTATIONS OF THE U.S. DOLLAR CERTIFICATES BY DIFFERENT CATEGORIES - SELECTED DATES. CR$/U.S.DOLLAR

	Categories*				
End of	I	II	III	IV	V
1953, Dec.	18	28	47	62	116
1954, Mar	30	34	55	91	111
Jun	18	24	57	77	132
Sep	37	42	89	98	156
Dec	43	60	135	151	181
1955, Jan	46	66	136	200	222
Feb	56	71	171	240	400

Source: International Financial Statistics, April 1955

(*) For a definition of the categories see note 14 at the end of the chapter.

Because of the various difficulties presented by such a complex system, in August, 1957, it was replaced by an ad valorem tariff on imports and a consolidation of the original categories into two: "general" category comprising of the old categories, I, II, III, and part of IV (about 95 percent of all auction imports) and a "special" category for the remainder (considered superfluous).[16] Foreign exchange, however, was still purchased in the auction market. Table 3 reports some effective auction rates (buying rate of Cr$18.92 plus the price paid for the auction certificate) for U.S. dollars in Rio de Janeiro.[17]

Table 3

EFFECTIVE AUCTION RATES FOR U.S. DOLLAR IN JUNE-JULY OF 1969 IN RIO DE JANEIRO. CR$/U.S. DOLLAR

Months	Categories	
	General	Special
June	234.92	532.62
	233.92	516.06
	226.92	499.41
	231.92	491.90
July	230.92	491.59
	229.64	478.38
	228.52	494.86
	226.08	495.89

Source: International Financial Statistics December 1960.

In March 1961 SUMOC moved toward a free market by instituting a single exchange rate. Imports started to be effectuated at free market rates and subsidies to purchase petroleum, wheat and printing paper were eliminated but the auction system remained for the special category. However, with the establishment of the "free market," the exchange rate began to depreciate at a faster rate than the domestic rate of inflation and because of the impact of political instability that occurred at this time on the balance of payments, soon the "free rate" came to be set by the monetary authorities, while subsidies to petroleum and wheat imports were restored.[18]

From 1962 to 1968 Brazil experienced a fixed exchange rate system within the Bretton Woods scheme with adjustments of the exchange rate from time to time. It is useful to divide this period into 2 phases. One, prior to February 1964, was characterized by the existence of the "puppet" (boneco), an agio paid by the importer to the exporter without which the latter would not be willing to sell his foreign exchange earnings. The other, starting February 1964, when SUMOC incorporated such a "puppet" into the exchange rate, until August 1968.

There seems to be no controversy regarding the reasons for the appearance of this agio, which occurred in January 1962. With the monetary authorities' decision to reunify the exchange rate, fixing a buying and selling rate for all operations despite the continuous rise in domestic prices, exports soon began to diminish and expectation of a devaluation induced the exporters to delay negotiation of their bills of exchange except in case of extreme necessity of cruzeiros. The consequence was a lack of coverage from the Bank of Brazil to other banks causing a scarcity of foreign exchange so that importing and

exporting clients of the same bank starting to make deals among themselves. In such deals, which later were extended to clients of various banks, the importer paid an additional "fee" (the puppet) beyond the official exchange rate.[19] From January 1962 until January 1963 there is no systematic record of the average "puppet" paid by importers. According to Conjuntura Econômica,[20] during February and March of 1962 this agio fluctuated between Cr$ 15.00 and Cr$ 25.00 per U.S. dollar. After May 21st of the same year when the monetary authorities devalued the cruzeiro, adopting new rates of Cr$350.00 and Cr$ 359.30 per dollar, for some time the "puppet" disappeared. This seems to have been a result of three more subsequent devaluations which took place in July and September of the same year (1962), with the help of the monetary authorities' decision to allow private banks to quote rates fluctuating up to 1 percent above or below the official ones after the devaluation of May 21st. Table 4 shows the official rates that prevailed in 1962.

Table 4

OFFICIAL EXCHANGE RATES IN 1962. CR$/U.S DOLLAR

Date Effective	Buying Rate	Selling Rate
January 3rd	310.00	318.00
May 21st	350.00	359.30
July 1st	355.00	370.00
July 7th	357.00	367.00
September 6th	460.00	475.00

Source: Conjuntura Econômica, various issues, 1962/63.

Yet the "puppet" was back by mid-October and fluctuated between Cr$ 13.00 and Cr$ 20.00 per U.S. dollar until the end of November. It reached Cr$ 80.00 in the second half of December, and fluctuated between Cr$ 80.00 and Cr$ 90.00 in mid-January of 1963.

Daily quotations of the "puppet" are available from February 15th, 1963, to February 10th, 1964, when it disappeared with the advent of a SUMOC Instruction incorporating it in the exchange rate. Then, after a period of apparently firm position, the exchange rate for general commodities was devalued in August of 1964 and again at the end of December of the same year. Only with the institution of the new cruzeiro[21] in November 1965 was there another devaluation and before the advent of the so-called mini-devaluation system in August of 1968 only 2 more devaluations occurred: one in February of 1967 and another in January of 1968. Thus on the average, between February 1964 and August 1968 the Brazilian monetary authorities devalued the cruzeiro every 10 months.

It should be emphasized that during this period the parallel market (black market) was in great evidence especially in the second half of March 1964 when Brazilian political instability reached its peak. Also, the practice of lagging devaluation behind inflation, as was done by the Brazilian monetary authorities, created difficulties for the balance of payments. Such difficulties however, were attenuated by a greater net inflow of foreign capital, principally beginning in 1966 due to investors' confidence in the new government.

Another feature of this period of large but infrequent devaluations was the movement of speculative capital. Since the domestic rate of inflation was much greater than the foreign rate speculators anticipated devaluations in Brazil so that there were substantial outflows of capital

prior to each one. Inversely, following each devaluation large inflows of foreign capital took place, apparently to take advantage of the high interest rate in Brazil. Evidently, such flows of speculative capital brought cyclical crises to the brazilian financial system, hindering efforts by the monetary authorities to fight domestic inflation.

To summarize the evolution of the exchange rate from 1946 to 1967 we present the figures reported by Conjuntura Econômica, as the most representative of exchange transfers. These figures, shown in Table 5, represent the exchange rate applicable to imports of a general character and the exchange rate applicable to transactions which have been independent of any government action and hence termed the "free" market rate.[22] Both rates represent yearly averages taken as simple averages of the monthly averages in Tables 10 and 11 in the appendix.

Figure 2 shows the path of percentage variations in the exchange rates. With respect to the import exchange rate, we notice a flat portion in the 1947-1952 period, an appreciation of the cruzeiro in 1957, and large depreciations in 1953-1955, in 1958, and in 1962-1965.

The flat portion corresponding to the 1949-1952 period represents both the immediate postwar period and the license period when the exchange rate was maintained constant. The large depreciations of 1953-1955, especially the peak of 1953, are due to the adoption of a free market in February of that year and to the introduction of the so-called auction system which brought an effective depreciation of the cruzeiro. By 1953 the cruzeiro was considerably overvalued because of the maintenance of a fixed exchange rate despite the continuous rise in domestic prices.

The appreciation of 1957 was caused by the establishment of the ad valorem tariffs for imports, which reduced the demand for foreign ex-

Table 5

EVOLUTION OF THE EXCHANGE RATE, 1946-1967

Years	Import Rate		"Free" Rate	
	NCr$/U.S.$	% Variation	NCr$/U.S.$	% Variation
1946	0.019	-	0.020	-
1947	0.019	0.00	0.023	0.15
1948	0.019	0.00	0.027	0.17
1949	0.019	0.00	0.029	0.07
1950	0.019	0.00	0.032	0.10
1951	0.019	0.00	0.030	-0.06
1952	0.019	0.00	0.034	0.13
1953	0.043	1.26	0.045	0.32
1954	0.062	0.44	0.063	0.40
1955	0.099	0.60	0.074	0.17
1956	0.112	0.13	0.074	0.00
1957	0.087	-0.22	0.077	0.04
1958	0.165	0.90	0.132	0.71
1959	0.221	0.34	0.160	0.21
1960	0.229	0.04	0.190	0.19
1961	0.279	0.22	0.291	0.53
1962	0.387	0.39	0.523	0.80
1963	0.617	0.59	0.903	0.73
1964	1.234	1.00	1.536	0.70
1965	1.893	0.53	1.920	0.25
1966	2.220	0.17	2.213	0.15
1967	2.663	0.20	2.860	0.29

Source: Tables 10 and 11 in the Appendix.

change. This brought down the auction premium and thus the effective exchange rate. The depreciation of 90 percent in 1958 was perhaps due to a return of the demand for foreign exchange to its previous level after the initial impact of the increased tariffs.

Finally, the large depreciations of the 1962-1965 period reflect the political crisis which reached its peak in 1964 and domestic inflation at the highest level ever experienced in Brazil.[23]

The 1968-1976 Period

In August 1968 in an evident move to dampen the adverse movements of speculative capital and to improve the balance of payments via an increase in exports, Brazil shifted to a new exchange rate policy with more frequent but smaller devaluations. Since then the Central Bank has been announcing the new exchange rate for purchase and sale of the U.S. dollar in variable intervals ranging from 12 to 85 days.

As can be calculated from Table 12--without considering the period between December 16, 1972, till February 14, 1973, when the cruzeiro's only revaluation occurred because of the depreciation of the U.S. dollar in terms of gold--from August 27, 1968, to December 22, 1976, there were 80 devaluations, with an average of approximately 1.5 percent each. The average period between devaluations was 37 days.

Table 6 reports the evolution of the exchange rate on an annual basis for the period.

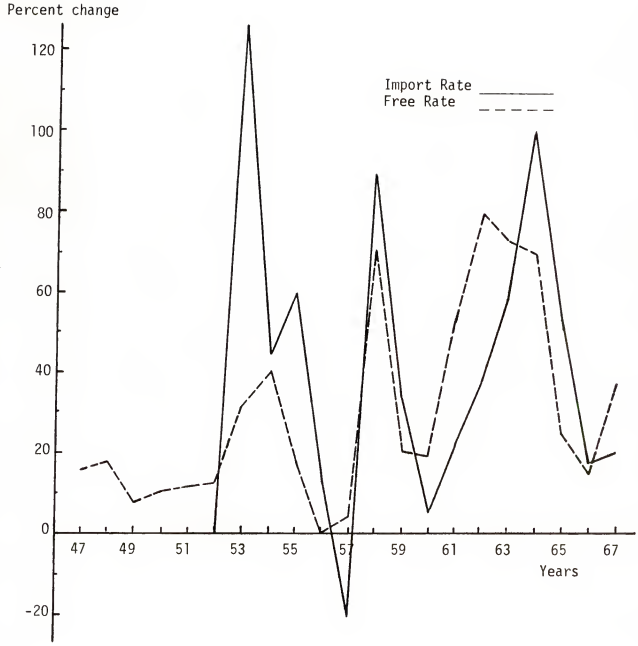

Figure 2

Annual Percentage Variations of the Import and Free Exchange Rates, 1947-1967

Table 6

EVOLUTION OF THE EXCHANGE RATE, 1968-1976

Years	Annual Averages NCr$/U.S.$	Percentage Variations
1968	3.395	27.5
1969	4.077	20.1
1970	4.597	12.8
1971	5.288	15.0
1972	5.935	12.2
1973	6.127	3.2
1974	6.793	10.9
1975	8.129	19.6
1976	10.677	31.3

Source: Calculated as weighted averages from data in Table 12 except that the figure for 1968 is derived partly from Table 10 (January-August) and partly from Table 12 (September-December).

Summary for the Whole Period - 1946-1976

Since the end of World War II Brazil has experienced several exchange rate systems. After a short period of free imports under a overvalued fixed exchange rate, there were rigid exchange controls from 1947 to 1953 characterized by import restrictions through a system by which any import required a license granted by the Bank of Brazil. During this period an official rate of Cr$ 18.72 per U.S. dollar prevailed until January 1953. From February to September of 1953, except for those imports of national interest which continued to be effected at privileged official rates, imports were purchased at a free market rate.

From October 1953 to 1961 Brazilian exchange rate policy was characterized by the so-called "exchange auction system," a system of multiple rates. According to this system, imports had to be paid through the official market rate, plus a premium that varied in accordance with bids made during the exchange auction, plus, eventually, a tax on remittances.

Until mid-August of 1957 imports were classified into 5 categories with the most essential grouped into category I and the least essential into category V. For each category there was a minimum bid to be accepted by the monetary authorities, during the auctions for the different currencies which were carried out almost every week.

In mid-August of 1957 the 5 categories were replaced by only 2 (the general and special categories) but the exchange auctions remained in force.

From March until December of 1961 there was another attempt by the Brazilian monetary authorities to establish a free market rate but it did not succeed.

From 1962 to August of 1968, roughly, Brazil followed a fixed exchange rate within the Bretton Woods scheme of large adjustments from time to time. In view of the persistent inflation and of the relatively long periods between devaluations, imports became cheaper and exports dearer creating difficulties for the balance of payments. In addition there were evidences of strong movements of speculative capital, with substantial outflows and inflows of foreign capital before and after large devaluations.

Since August 1968 the Brazilian monetary authorities have used a system of devaluing the cruzeiro more frequently and in smaller amounts, as can be seen in Table 12. This new system--mini-devaluation-- is said to have been adopted primarily to improve the balance of payments via increase in exports and to avoid significant movements of speculative capital.

Although Brazilian monetary authorities are not officially committed to doing so, in fact, the current Brazilian system of devaluation represents an approximate application of the purchasing power parity theory. As can be seen using Figure 3, taking into account the percent change in the annual average of the import rate and the difference between the percent changes in the wholesale price indexes of Brazil and United States, after 1961 there is some indication that the exchange rate follows, somewhat the purchasing power parity theory, at least in a relative sense. Notice, however, that it is after 1968 that the evidence becomes stronger, with the percent change in the exchange rate following closely the inflation rate differential.[24]

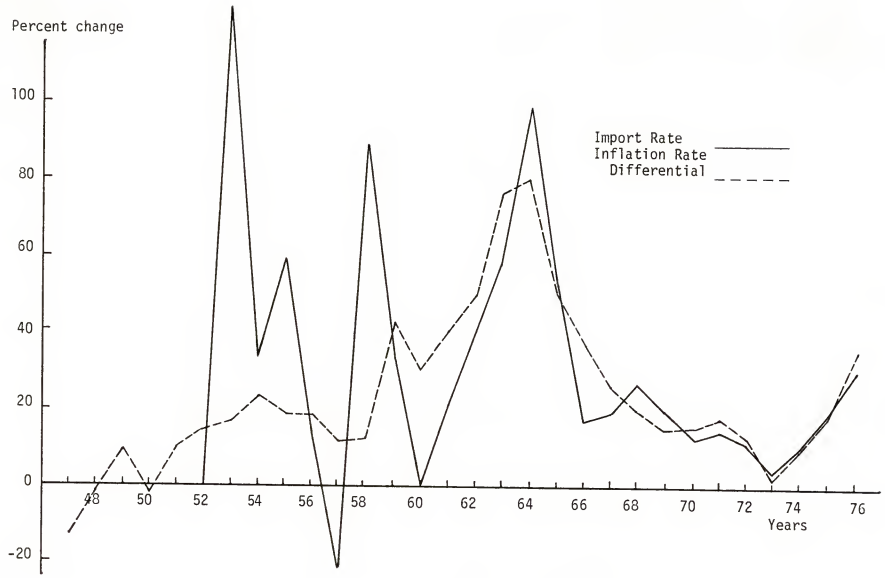

Figure 3

Percent change in the Import Exchange Rate (Cruzeiros/U.S. $) and the Inflation Rate Differential (Brazil-U.S.), 1947-1976.

Notes

[1]We consider only those monetary variables that in the long run are most likely to affect the overall balance of payments under a strictly monetaristic point of view, i.e., price level, money supply and the exchange rate.

[2]According to Decree-Law No 7293 of February 2, 1945, which created the SUMOC.

[3]By Law No 4595 of December 31, 1964, which established the basis for the current financial system.

[4]The following description of the National Financial System is based on the text of Law 4595 and on a report in Documents on Brazil 4 - Survey of the Brazilian Economy, Washington, D.C., Brazilian Embassy, 1966, pp. 270-277.

[5]In January 1976 the Central Bank had 9 Regional Agencies installed in the capitals of the following states: Pará, Ceará, Pernambuco, Bahia, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, and Rio Grade do Sul.

[6]See Syvrud (1974, p. 61). According to data of the Central Bank reported in Conjuntura Econômica of April 1975, from 1970 to 1974 the Bank of Brazil alone accounted for 35.1 percent of the loans of the banking system to the private sector.

[7]See Syvrud (1974, pp. 61-62).

[8]For a brief description of the principal development funds see "Documents on Brazil 4 - Survey of the Brazilian Economy," 1966. Brazilian Embassy, Washington, D.C., p. 276. For a summary of the principal funds and programs administered by the Central Bank, see Banco Central do Brasil, Relatório Anual, 1974, pp. 82-83.

[9]For a brief presentation of the Exchange Rate Policy in Brazil during the postwar period (1946-1974) with emphasis on export policies, see Tyler (1976, pp. 190-204).

[10]For a detailed analysis of this license period see Huddle, Donald L., "Balanco de Pagamentos e Contrôle de Câmbio no Brasil, Diretrizes Políticas e História, 1946-1954." Revista Brasileira de Economia, Vol. 18, 1964, No 1, pp. 5-40.

[11]By Law 1807 of January 7, 1953. This move to a free market rate may indicate that the government had realized the impossibility of maintaining a fixed official rate of Cr$ 18.72 per U.S. dollar as Gudin (1956, p. 502) pointed out.

[12]The system of auctions was brought about by Institution No 70 of September of 1953 of SUMOC.

[13]The par rate was established at Cr$ 18.50 per U.S. dollar. The premia were at first fixed at Cr$ 5.00 per dollar on coffee exports and at Cr$ 10.00 per dollar on all other exports. See Conjuntura Econômica of January 1970, p. 60.

[14]Those goods considered most essential were grouped in the first category and those considered least essential in the last. By mid-1955 the principal commodities in the various categories were: category I - agricultural supplies such as machinery, fertilizers, insecticides, and barbed wire. category II - ores, snap metals, and other raw materials; category III - wood, industrial machinery, equipment, and vehicles; category IV - office machinery, fresh fruits, and some consumer goods; category V - commodities not included in the first 4 categories. See International Financial Statistics of April 1955, p. 56.

[15]By February 1955 the official rate was Cr$ 18.82 per U.S. dollar. The tax on remittances (exchange tax) which was first established on January 1, 1948, at a level of 5 percent (computed on the official rate) was raised on January 1, 1952, to 8 percent and to 10 percent on January 1, 1955. See International Financial Statistics of October 1954 and April 1955, pp. 59 and 56 respectively.

[16]According to Law 3.244, of August 14, 1957 (Customs tariffs). Prior to this law there were specific tariffs which, in view of the continued inflation, became ineffective within the protectionism involved in the Brazilian import substitution strategy.

[17]For more comments on this period of auctions see A. Kafka, "The Brazilian Exchange Auction System." The Review of Economics and Statistics, August, 1956, pp. 308-322. See also E. Gudin, "Multiple Exchange Rates - the Brazilian Experience." Economia Internazionale, August, 1956, pp. 501-509.

[18]See Tyler (1976, p. 194) and Conjuntura Econômica of January, 1970, p. 61.

[19]Only the Bank of Brazil and a restricted number of private banks authorized to deal with foreign exchanges carried out their transactions through official rates. In fact the appearance of the "puppet" seems to have been a move of the monetary authorities to make "de facto" partial devaluations.

[20]See various issues of 1962 and 1963, section on foreign exchange market.

[21]One thousand cruzeiros became equal to 1 new cruzeiro after November 1965.

[22]Those rates with either favorable or unfavorable exchange treatment such as those related to government imports and imports classified into the special category established by the Customs Tariff Law are excluded from the calculation of the import rate. As for the "free market rate", according to the period it embraces the free rate and the "parallel" or "black" markets.

[23]During 1962-1965 the annual rates of growth of the Brazilian economy were 5.3 percent, 1.5 percent, 2.9 percent and 2.7 percent, respectively, in terms of gross domestic product whereas the rate of inflation, in terms of the general price index, reached respectively 51.6 percent, 75.4 percent, 90.5 percent, and 56.8 percent. It should be recalled that in 1960 and 1961 the corresponding rates of growth were 9.7 percent and 10.3 percent and the rates of inflation were 29.2 percent and 37.0 percent.

[24]Wholesale price indexes and their respective percent changes are reported in Table 14 in the appendix.

CHAPTER III

THE MONETARY APPROACH TO THE BALANCE OF PAYMENTS

Introduction

Historically, the balance of payments has been a major concern of economists. Among the early literature on the subject the best known is the price-specie flow mechanism of David Hume (1969), by which accumulation of specie proportionately greater than the production of goods and services raises domestic prices and so decreases exports.

Imports, by their turn, become relatively cheaper so that a deficit in the balance of trade must occur. The net outflow of specie however, gradually depletes the excess of specie at home bringing domestic prices to lower levels while accumulation of specie abroad tends sooner or later to increase foreign prices. Continuation of this process restores the previous relative prices so that the balance of trade automatically achieves its equilibrium.

More recent literature on the balance of payments includes different interpretations of how an imbalance occurs. Most authors are concerned particularly with the question of whether a devaluation of the exchange rate improves the balance of payments. Along this line, three approaches have become familiar: the elasticity, the absorption, and the monetary approaches.[1]

The elasticity approach can be summarized in the proposition that the effect of a change in the exchange rate on the balance of payments depends on the elasticities of the demand and supply of both imports and exports with respect to their relevant prices.

The greater the elasticities of demand are, the greater is the likelihood that a devaluation will improve the balance of payments. In fact, if both the supply of imports and the supply of exports are infinitely elastic with respect to their relevant prices, it can be shown that starting from a position of equilibrium a devaluation will improve the balance of payments (the balance of trade) whenever the sum of the elasticities of the demands for imports and exports exceeds unity--the so-called Marshall-Lerner condition.[2]

A limitation of this approach is that it is not suitable for a fully employed economy in view of its implicit assumption of existing available resources to produce more exportable goods.[3] Apart from this minor problem there is also the fact that its empirical usefulness has been put in doubt.[4]

The appearance of S. S. Alexander's "absorption approach" is said to have been a consequence of the recognition in the postwar period that the "elasticity approach" was incompatible with the then existing full and over-full employment because of its implicit assumption of existing unemployed resources.

Alexander's approach rests basically on the following identity:

$$B \equiv Y - A$$

where: B = balance of trade;

Y = income;

A = domestic expenditure;

all of which measured in domestic currency unity.

His argument is that for a fully employed economy the effect of a devaluation on the "balance of payments" does not depend on the elasticities of the demand for imports and exports. Instead, it depends on how the rise in domestic prices resulting from devaluating affects domestic absorption (A) primarily through a cash balance effect, an income redistribution effect and a money illusion effect.[5]

In short, the common feature of these two interpretations is that they still follow the traditional view that although a particular policy, such as devaluation, might affect other accounts of the balance of payments, the relevant impact is on the balance of trade. From a theoretical point of view the merits of these approaches cannot be contested if one defines properly what he means by the balance of payments when referring to either one. However, it should always be emphasized that movements in the balance of trade are not necessarily identical to movements in the overall balance of payments.

In what follows we shall present the essence of the monetaristic view of the balance of payments: the monetary approach, which has recently received special attention due, perhpas to two virtues well stressed, for example, by Magee (1976); first, it avoids the possibility of error of identifying movements in the balance of payments components with identical movements in the overall balance of payments; second, being very simple it can be understood and used by policy makers, fulfilling therefore an important requirement for any useful theory.

After representing the essence of such an approach we shall report a synthesis of the model developed by Girton and Roper (1977) which constitutes the basis of the present dissertation.

The Essence of the Monetary Approach

The theoretical literature on the monetary approach to the balance of payments is already vast, although substantial interest in this approach has appeared only recently. The contributors are many but among them we should cite R. A. Mundell (1968), H. G. Johnson (1972), J. A. Frenkel (1976), M. Connolly and D. Taylor (1976), and Girton and Roper (1977). Mundell and Johnson were the first to establish the basic theoretical implications of the monetary approach in a systematic manner, although according to the latter, the theoretical basis of this recent orientation could be traced back to the work of J. J. Koopmans. Indeed, if it were not for the fact that Hume emphasized the role of relative prices in the adjustment of the balance of payments, he could be regarded as the earliest contributor.

The essence of the monetary approach to the balance of payments, as the name itself suggests, is that adjustments in the monetary market, rather than relative price adjustments, are considered the main determinants of the behavior of the blaance of payments. In other words, under the monetaristic point of view, the balance of payments reflects the adjustment of the domestic money supply to its corresponding demand.

To see how the monetarists explain deficits or surplus in the balance of payments one must, in addition to supposing that no barriers hinder international transactions, look at two things. One is to assume that the monetary market is stable. That is, the supply of and the demand for money adjust to each other whenever a disturbance of any origin provokes an imbalance between them. For expositional purposes, the time of the adjustment is not relevant. It could be a

day, a month, a year, or any other period. The relevant point is to consider that sooner or later the money supply will be equal to the corresponding demand if any discrepancy exists between them. The other is to look at the components of the money supply.

If deficits or surpluses in the overall balance of payments affect the foreign asset holdings of both private monetary institutions (commercial banks) and the monetary authorities, commonly represented by the central bank, one suitable way to look at the components of the money supply is to consider the consolidated balance sheet of the monetary system as a whole as in Mundell (1971). A summarized presentation of this balance sheet can be expressed as follows:

Consolidated Balance Sheet: Monetary Authorities plus Commercial Banks

Assets	Liabilities
R	M
A	O

where R is net foreign assets, measured in domestic currency, which for expositional purpose we shall term indifferently international reserves or foreign exchange, A is assets other than foreign assets and is for this reason called domestic asstes; M is monetary liabilities identical to the usual money supply M1--currency held by the public plus demand deposits--and O stands for other liabilities or non-monetary liabilities. Since total assets must be identical to total liabilities, it directly follows that:

$$(1) \qquad M \equiv R + D$$

where D, equal to A minus O, is traditionally called domestic credit or domestically created money.[6]

Identity (1) reflects clearly a simple but very important conclusion for the monetaristic argument: the money supply is made up of two distinct components--net foreign assets of the monetary system and domestically created money.

A second important assumption usually adopted by the monetarists is that changes in money created domestically, whether by the monetary authorities or by commercial banks, is independent of changes in net foreign assets under a fixed exchange rate. That is, given a fixed exchange rate, ΔD is independent of ΔR, which, by definition is the balance of payments in domestic currency.

Given that the demand for money, which we shall call L, adjusts to the supply of money M, we may write:

$$(2) \qquad R + D = L$$

which expresses the equilibrium of the monetary market. On this equilibrium--assumed to be stable--rests the essence of the monetary approach to the balance of payments. Suppose, for example, that for some reason there exists an excess supply of money. This means that people are trying to dispose of their excess cash balance so that as long as the exchange rate remains fixed, more foreign exchange will be purchased to make payments abroad. As a result, the net stock of foreign assets decreases, worsening therefore the balance of payments. The degree by which the balance of

payments is affected depends of course on how this excess supply will eventually affect the corresponding demand.

The most usual way of analyzing the effect of an excess supply of money is by considering an autonomous increase in domestic credit when the monetary market is in equilibrium. To provide further analytical instruments let ϵ_{LD} represent the total domestic credit-elasticity of the demand for money L, the specification of the arguments of L not being necessary for the moment. Let us only say that ϵ_{LD} measures the percent increase in total demand for money L, when domestic credit increases by 1 percent, after all adjustments in the money market take place. Since for most economies what matters is the balance of payments in foreign currency--although irrelevant in this case--let R be equal to ER* where E is the exchange rate--price in domestic currency of one unit of foreign currency--and R* is net foreign assets in foreign currency so that an increase in R* does reflect an improvement in the balance of payments in foreign currency. Bringing D to the right-hand side in (2) and then dividing both terms by E it follows that the monetary market equilibrium can be expressed by:

$$(3) \quad R^* = (L-D)/E$$

If ϵ_{R^*D} stands for the domestic credit-elasticity of the net stock of foreign reserves R*, it can easily be shown from (3) that the following relationship must hold:

$$(4) \quad \epsilon_{R^*D} = \frac{M}{R}\left(\epsilon_{LD} - \frac{D}{M}\right)$$

This expression shows that the conclusion that an increase in domestic credit leads to loss of international reserves necessarily implies assuming that the domestic credit-elasticity of the demand for money is less than the ratio of domestic credit to the money supply. In fact it is customarily assumed for small open economies that the demand for money is insensitive to domestic credit creation so that (4) collapses to $\Delta R^* D = -D/R$. This makes the negative effect of domestic credit creation on the balance of payments unambiguous. A small country, having, for instance, one-fifth of its money supply in foreign assets, would lose 20 percent of its international reserves valued in foreign currency if it raised domestic credit by 5 percent provided, of course, that the variables directly affecting the money demand were allowed to change only due to the change in domestic credit. On the assumption of a relatively insignificant ability of changes in domestic credit to affect the demand for money and so on its inability to affect the domestic money supply noticeably, rests therefore the position defended by the monetarists that monetary policy and so the control of domestic credit determines the country's net flows of international reserves and hence its balance of payments.

The basic monetaristic argument regarding the role of the exchange rate is that a devaluation improves the balance of payments not due to changes in relative prices, but rather because it raises domestic prices increasing therefore the demand for money. In fact, the resulting excess demand for money should eventually increase the money supply via an increase in net foreign assets in domestic currency. However, when devaluation takes place, foreign assets in domestic currency automatically increase due to the increase in

the exchange rate. Do foreign assets in foreign currency also increase implying an improvement in the balance of payments? To answer this question let ϵ_{R^*E} and ϵ_{LE} stand respectively for the exchange rate-elasticity of net foreign assets in foreign currency and for the exchange rate-elasticity of the demand for money L. Again from (3), one can easily derive the expression:

$$(5) \qquad \epsilon_{R^*E} = \frac{M}{R} \left(\epsilon_{LE} - \frac{R}{M} \right)$$

which says that a devaluation will successfully improve the balance of payments in foreign currency whenever the exchange rate-elasticity of the demand for money exceeds the ratio of net foreign assets measured in domestic currency to the money supply. Since for small open economies R/M is usually very low and ϵ_{LE} high--for analytical and empirical purposes assumed very often to reach unity--it follows that for these cases a devaluation must always be successful.

For empirical studies one has to specify the demand for money and work with more adequate variables. As an example let us assume a stable demand for money exists, following the classical quantity theory of money, and that the domestic price level is pegged to the world price level by the purchasing power parity theory (PPP) so that we may write:

$$(7) \qquad L = kpy$$

$$(8) \qquad p = Ep^*$$

where: L = demand for nominal money;

k = constant;

y = permanent real income;

p = domestic price level;

E = exchange rate, or domestic currency price of the foreign currency;

p^* = foreign price level.

Assuming in addition that the domestic money supply adjust properly to the corresponding demand, from identity (1) and equations (7) and (8) we may also write:

$$(9) \quad R + D = kEp^*y$$

which shows directly that, as long as the exchange rate is maintained constant and domestic credit creation does not increase the world price level and the level of permanent income, any increase in domestic credit worsens the balance of payments since R has has to decrease. From (9) one can also conclude that a devaluation of the domestic currency leads to an increase in money demand and necessarily to an improvement in the balance of payments. The usual way this simple model is applied in empirical studies is by bringing D to the right-hand side and expressing the equation in terms of percentage changes in the variables, so that a suitable regression equation to explain the proportional balance of payments, using ordinary least squares, can be obtained.

These are the fundamental ideas embodied in the monetary approach. A complete discussion can be found in Johnson (1972), where he develops a set of formulas derived under different assumptions relating the balance of payments, the rate of inflation, the rate of expansion of domestic credit, the rate of growth of real product and the rate of

growth of international reserves for the world. He begins with a simple model involving a single country, which is growing over time, under fixed exchange rates with prices and interest rates pegged to those of the world and goes gradually to more complex situations in which monetary equilibrium for the whole world is taken in consideration.

The current literature on the subject also contains more ambituous works from a theoretical point of view.[7] However, for empirical purposes--our primary interest--these ideas set forth by Johnson have proved to be the most useful for being more applicable. In fact the empirical work already done--which is scant--concerns mostly the application of the simple model involving the small country assumption under a fixed exchange rate. On this line we could cite the works of Hans Genverg (1974, 1976), J. Richard Zecher (1976), Donna L. Bean (1976), Manuel Guitian (1976) and Michael Connolly and Dean Taylor (1976). Connolly and Taylor, for instance, test the impact of devaluation on the balance of payments for developing countries using a model similar to equation (9). Applying first differences and making the simplifying assumption of a constant rate of growth of permanent income valued at world prices they derive the following model:

$$(10) \qquad \Delta \frac{B}{M} = (1 + g) \frac{\Delta r}{r} - \Delta \frac{\Delta D}{D}$$

where:

B = balance of payments;

M = money supply (M1);

r = exchange rate;

D = domestic credit;

g = rate of growth of permanent income valued at world prices.

Application of this model to a sample of 18 independent devaluations that occurred in developing countries from 1959 to 1970 permits them to conclude that changes in the exchange rate significantly affected changes in the balance of payments after two years, This study also confirmed the role of domestic credit creation as a determinant of the balance of payments according to this model's predictions.

A Model of the "Exchange Market Pressure"

In this section we present a summary of a monetary model developed by Lance Girdon and Don Roper. The reason such a summary is reported here is twofold: first, by being applicable to any exchange rate system and to practically any open economy, their model breaks way from the tradition existing until recently of restricting the application of the monetary approach to the balance of payments to empirical studies employing--in general--models of small countries with fixed exchange rates; second, as stated earlier, their model constitutes the basis of our empirical study.

The Model

As with most presentations of monetary models related to the balance of payments, Girton and Roper begin by assuming the monetary equilibrium condition for a certain country i may be expressed by the following relationship

$$(11) \quad H_i = F_i + D_i = P_i Y_i^{\beta i} \exp(-\alpha_i \rho_i)$$

where the right-hand side term is their specified demand for base money and the symbols are as follows:

H_i = supply of base money issued by the central bank of country i;

F_i = base money created against the purchase of foreign assets;[8]

D_i = base money created by domestic credit expansion;

P_i = price level;

Y_i = real income;

ρ_i = index of interest rates;

β_i = income elasticity > 0;

α_i = interest rate coefficient > 0;

They next took the time derivative of (11) and stated the results as percent changes:

$$(12) \qquad h_i = r_i + d_i = \Pi_i + \beta_i y_i - \alpha_i \rho_i'$$

where: $h_i = H_i'/H_i \qquad d_i = D_i'/H_i \qquad r_i = E_i R_i'/H_i$

$$\rho_i'(t) = d\rho_i/dt \qquad \Pi_i = P_i'/P_i \qquad y_i = Y_i'/Y_i$$

and primes denote derivatives with respect to time.

To analyze the monetary interaction between country i and another country j they subtract the monetary equilibrium condition (12) for the latter from that in (12). Then by assuming equality of the two interest rate coefficients--α_i and α_j, both equal to α--and introducing the additional notation:

e_{ij} = rate of appreciation of currency i in terms of currency j;

θ_{ij} = $\Pi_i - \Pi_j + e_{ij}$ = differential inflation rate adjusted for exchange rate changes;

δ_{ij} = $\rho_i' - \rho_j'$ = change in the uncovered interest rate differential;

they derive:

$$(13) \quad r_i - r_j + e_{ij} = -d_i + d_j + \beta_i y_i - \beta_j y_j + \theta_{ij} - \alpha\delta_{ij}$$

where $h_j = d_j + r_j$

The confirmation of their argument is straightforward taking into account the fact that h_j is identical to d_j plus r_j. In fact, r_j reflecting changes in international reserves of country j, can be affected by e_{ij} or r_i. However, if complete sterilization takes place in country j, by definition, changes in r_j will be offset by changes in d_j so that h_j will not be influenced by either r_i or e_{ij}.

To provide a suitable equation for testing the explanation of this composite variable $r_i + e_{ij}$ which they term the "exchange market pressure" of country i, they further assume θ_{ij} and δ_{ij} as determined by the reduced form functions:

$$(15) \quad \delta_{ij} = \delta_1 d_i + \delta_2 h_j + \delta_x X$$

$$(16) \quad \theta_{ij} = \theta_1 d_i + \theta_2 h_j + \theta_x X$$

where X is a vector of variables other than d_i and h_j that could affect δ_{ij} and θ_{ij}, and the coefficients of d_i and h_j are expected to present the following characteristics: θ_1 and δ_2 are not less than zero; and θ_2 and δ_1 are not greater than zero.

Substituting (15) and (16) into (14) and dropping the vector X they obtain:

$$(17) \qquad r_i + e_{ij} = -\emptyset_i d_i + \emptyset_j h_j + \beta_i y_i - \beta_j y_j + v$$

where v is an error term and the coefficients of d_i and h_j are as follows:

$$\emptyset_i = 1 + \alpha\delta_1 - \theta_1, \ \delta_1 \leq 0, \ \theta_1 \geq 0$$
$$\emptyset_j = 1 - \alpha\delta_2 + \theta_2, \ \delta_2 \geq 0, \ \theta_2 \leq 0$$

Given that d_i, h_j, y_i and y_j are independent of each other and independent of the left-hand side variables and also that the demands for base money and the reduced forms (15) and (16) are properly specified, this model--as Girton and Roper claim--presents the following features:

a) it provides a direct link between the "exchange market pressure" in country i and the rest of the world, for which monetary conditions are represented by the monetary conditions in country j;[9]

b) it emphasizes that, ceteris paribus, an expansionary monetary policy will create an adverse "exchange market pressure" forcing depreciation of the domestic currency, loss of foreign reserves, or both;

c) it permits empirical testing of whether country i can control its monetary base--a significantly less-than-unity estimate for $\emptyset_i$ would indicate that the monetary authorities do have some control of the monetary base under a fixed exchange rate;

d) provided that the "exchange market pressure" $r_i + e_{ij}$, is independent of its composition it can be applicable to any exchange rate system.

Girton and Roper test this model for the postwar Canadian experience vis-à-vis the U.S. arguing that the United States as a center or key-currency country has been able to sterilize completely its change in net foreign assets. The period used is 1952-1974 during which the Canadian dollar floated until 1962, was fixed in relation to the U.S. dollar from 1963 to June 1970, and floated again afterwards.

They estimated equation (17) using the percent change in three alternative U.S. aggregates reflecting monetary conditions in this country: the U.S. base money (the most appropriate measure according to the model), M_1, and M_2.

They obtain excellent fits for all cases in the sense that all estimated coefficients have the predicted signs and are significantly different from zero, and the coefficients of determination adjusted for degrees of freedom are high: equal to 0.96, 0.95 and 0.92 using respectively the above mentioned aggregates.

A strange result, however, appears to nullify, at least in part, that excellent fit: the estimated income elasticities of the demand for base money for both the United States and Canada are significantly greater than 1 at the 5 percent confidence level in all three estimated equations with the single exception of the estimated income elasticity of demand for base money in Canada--which nevertheless remains significantly greater than 1 at the 10 percent level--in that equation where Girton and Roper use the percent change in M2 in the United States as a proxy for the change in its base money.

To test whether the "exchange market pressure" was independent of its composition they reran all three equations using e_{ij}/r_i as an additional regressor and in view of the results they conclude that the way $r_i + e_{ij}$ was being absorbed exerted no influence upon this composite variable. The problem is that this ratio e_{ij}/r_i clearly is discontinuous when r_i assumes a value equal to zero so that the test they carried out has no relevance.

Another point worth mentioning is related to the way they treat the problem of biasedness of $\hat{\emptyset}_i$ under a fixed exchange rate.[10] They begin by assuming the following reaction function of the monetary authorities:

$$(18) \qquad d_i = d_i^{\circ} - \lambda_i r_i$$

where d_i° is the portion of d_i exogeneously directed to targets other than sterilization and λ_i is the coefficient of sterilization--a λ_i equal to one indicating complete sterilization and a λ_i equal to zero indicating no sterilization at all.

Next, under the simplifying assumption that h_j, y_j and y_i are independent of d_i--an appropriate treatment--they derived the asymptotic bias for $\hat{\emptyset}_i$ obtaining:

$$(19) \qquad \text{plim}\ (\hat{\emptyset}_i - \emptyset_i) = (1 - \lambda_i \emptyset_i) \frac{\lambda_i}{\sigma^*/\sigma_v + \lambda_i^2}$$

where σ^* and σ_v stand respectively for the variances of d_i° and of the error term in (17). This is the correct formula, given (18). However, to state, as they do, that $\hat{\emptyset}_i$ tends to $1/\lambda_i$ asymptotically when σ^*/σ_v tends to zero is not an appropriate treatment although,

mathematically, the statement is correct. In fact, to say that plim $\hat{\beta}_i = 1/\lambda_i$ is senseless. An adequate expression would indicate that plim $\hat{\beta}_i$ should approach the true value of β_i when λ_i tends to zero and not approach infinity as $1/\lambda_i$ suggests. The cause of the problem is clear. To assume σ^*/σ_v tends to zero is equivalent to assuming σ^* tending to zero. But σ^* equal to zero is the same as saying that d_i^o is constant so that by (18) one can see that when λ_i tends to zero d_i also converges to a constant which clearly forces β_i toward infinity. Thus, in summary, what plim $\hat{\beta}_i = 1/\lambda_i$ says is that when λ_i approaches zero, d_i in (17) converges to a constant so that $\hat{\beta}_i$ increases exaggeratedly which is trivial. They should have stopped with (19).

Girton and Roper's model however, should not be judged by a few empirical results or by the way they conducted particular points in their empirical study. Instead it should be judged by its creativity substantiated in the attempt to explain the composite variable $r + e$, a very useful innovation in monetary models of the balance of payments. Being applicable to any exchange rate policy, it is more flexible than the traditional models and opens the door for further empirical investigations.

In the chapter that follows we present a simplified version of their model which was tested for the Brazilian case.

Notes

[1]For a simple geometric exposition regarding the three approaches see H. Johnson (1976). For an empirical comparison see H. Genberg (1974).

[2]See for instance G. Haberler (1969, p. 117).

[3]See H. Johnson (1972, p. 1557).

[4]See H. Genberg (1974, p. 27).

[5]For a full exposition of this approach see "Effects of a Devaluation on the Trade Balance," by S. S. Alexander in IMF Staff Papers, Vol. II (April, 1952), pp. 263-278.

[6]This derivation is similar to that of Mundell (1971, pp. 90-91).

[7]For a survey of the monetary approach to analysis of the balance of payments see Marina V. N. Whitman (1975).

[8]To avoid the gains of capital when devaluation occurs they defined the stock of foreign assets as:

$$F_i(t) = \int_{-\infty}^{t} E_i(\tau) R_i'(\tau) d\tau$$

where $R_i(t)$ is the stock of international reserves held by the monetary authorities in country i, $R'(t)$ is the time derivative of R_i and $E_i(t)$ is the price of primary reserve assets at time t in terms of domestic currency.

[9]They claim that as long as a country has the ability to sterilize completely its net flows of foreign reserves, its monetary conditions can be considered as a good proxy for those of the world.

[10]In fact to derive a formula for the asymptotic bias of $\hat{\emptyset}_i$ one need not consider a fixed exchange rate. In the next chapter we shall present a formula without this constraint.

CHAPTER IV

A SIMPLE MONETARY MODEL OF "EXCHANGE MARKET PRESSURE"

The model we present here is based on the model developed by Girton and Roper (1977). The chief difference is that we use M1 in the equation for monetary equilibrium and not the supply of base money as they do.

We consider an open economy too small to influence the world price level and assume purchasing power parity applies.

If in addition we assume that the demand for money follows the quantity theory we can write the following relationships:

$$(1) \quad L = kpy$$

$$(2) \quad p = Ep^*$$

$$(3) \quad M = L$$

$$(4) \quad M \equiv R + D$$

Equations (1) to (3) express respectively the demand for money, the purchasing power parity theory and the monetary equilibrium. The identity (4) comes from the summary of the balance sheet of the consolidated banking system: monetary authorities plus commercial banks. The symbols are as follows:

L = nominal demand for money;

k = constant;

y = level of real permanent income associated with long run full employment;

p = domestic price level;

E = exchange rate defined as the domestic currency price of the U.S. dollar;[1]

p^* = U.S. price level;

M = nominal money supply (M1);[2]

R = foreign reserves;

D = domestic credit.

Using the above four relationships we may write:

$$(5) \quad R + D = kEp^*y$$

Taking logs of both sides in (5) and then differentiating with respect to time, by approximation, we may also write:[3]

$$(6) \quad r + d = e + \dot{p}^* + \dot{y}$$

where: $r = \frac{\Delta R}{R + D}$, balance of payments as a proportion of the money supply;

$d = \frac{\Delta D}{R + D}$, rate of expansion of domestic credit as a proportion of the money supply;

$e = \frac{\Delta E}{E}$, percent change in the exchange rate;

$\dot{p}^* = \frac{\Delta p^*}{p^*}$, world inflation rate represented by the U.S. dollar inflation rate;

$\dot{y} = \frac{\Delta y}{y}$, rate of growth of permanent real income.

Transposing d to the right-hand side and e to the left-hand side we have:

$$(7) \quad r + e^* = -d + \dot{p}^* + \dot{y}$$

where $e^* = -e$, percentage appreciation (if positive) of the domestic currency

In what follows we shall assume that the right-hand side variables in equation (7) are independent of each other and independent of the left-hand side variables as well. An immediate implication of this assumption is that the value of $r + e^*$ will be the same regardless of the way the monetary authorities are handling the exchange rate.

To see this clearly let us represent equation (7) by the two original relationships;

$$(8) \quad r = -d + \dot{p} + \dot{y}$$

$$(9) \quad \dot{p} = \dot{p}^* - e^*$$

Equation (8) is derived from the monetary equilibrium, making use of equations (1), (3) and identity (4), and equation (9) comes from the purchasing power parity relationship (2).

Without loss of generality let us say that the rate of expansion of domestic credit (d) is equal to the rate of growth of permanent income ($\dot{y}$) so that the balance of payments as a proportion of the money supply (r), will be determined by the domestic rate of inflation ($\dot{p}$) in equation (8). Let the world inflation rate be set at the 8 percentlevel. Given that purchasing power parity holds,[4] if the government, for instance, maintains a fixed exchange rate ($e^* = 0$), the

balance of payments should improve by 8 percent as a proportion of the money supply since the domestic rate of inflation is pegged to the world inflation by purchasing power parity in (9). Once e^* was set equal to zero, the value of $r + e^*$ should be, of course, equal to 8 percent.

Suppose now that the government, instead, devalues the currency by 7 percent ($e^* = -0.07$). In this case, both the domestic rate of inflation and the proportional improvement in the balance of payments (r) should be 15 percent. However, the sum $r + e^*$ would remain the same, i.e., equal to 0.08 or 8 percent in accordance with equation (7).

Of course if d or $\dot{p}^*$ or $\dot{y}$ were affected by e^*, the "exchange market pressure" as Girton and Roper define $r + e^*$, would not be independent of the way the monetary authorities absorb it or, in other words, the "exchange market pressure" would not be independent of the government's exchange rate policy.

Assuming that $\dot{p}^*$ and $\dot{y}$ are largely independent of r or e^* is a common procedure and we think it reasonable here. First of all we are considering a country too small to influence the world rate of inflation. Second, $\dot{y}$ in this model refers to the rate of growth of real permanent income associated with long run full employment and so more likely to be affected only by changes in the production function and the supply of labor. Thus, in fact, the most significant assumption we are making is that the change in domestic credit creation as a proportion of the money supply (d) by either monetary authorities or private banks is determined independently of r or e^*, embracing therefore the usual assumption in monetary models of the balance of payments that sterilization does not take place.

Given that d, $\dot{p}^*$ and $\dot{y}$ are independent of each other and independent of the left-hand variables in (7), the "exchange market pressure" can be explained by the following regression equation:

$$(10) \quad r + e^* = \alpha_0' + \alpha_1 d + \alpha_2 \dot{p}^* + \alpha_3' \dot{y} + u$$

where u is an error term with the usual properties and the predicted values for the parameters are:

$$\alpha_0' = 0$$
$$\alpha_1 = -1$$
$$\alpha_2 = \alpha_3' = 1$$

An apparent difficulty in estimating the regression equation (10) arises from the lack of observed date for $\dot{y}$; the rate of growth of the permanent real income associated with the long run full employment. However, since in this case permanent income, as stressed above, is more likely to be affected only by structural changes such as shifts in the production function and the labor supply function, we may, reasonably, assume $\dot{y}$ to be constant over time, making $\dot{y} = \gamma$.

So doing yields a very simple and suitable regression equation for testing the model:

$$(11) \quad r + e^* = \alpha_0 + \alpha_1 d + \alpha_2 \dot{p}^* + u$$

where: $\alpha_0 = \alpha_0' + \alpha_3' \gamma$

In line with the monetary view of the overall balance of payments, this regression equation stresses that, under the stated assumptions, the "exchange market pressure" has to be primarily a monetary phenomenon.

Given the foreign inflation rate $\dot{p}^*$, the greater the rate of expansion of domestic credit, the greater will be the adverse "exchange market pressure," forcing, therefore, the monetary authorities to devalue their currency further if they are not willing to lose foreign reserves.

In addition to being applicable to any exchange rate policy, allowing in this way the pooling of fixed and variable exchange rate periods, regression equation (11) has the advantage of being very simple, requiring just a few series of data. As such, it is more widely applicable than other such equations considering the limitations of the data available in most of countries meeting the conditions required by the underlying assumptions. Another advantage of equation (11) is that the problem of multicolinearity is much reduced.

The possibility of bias for the estimated coefficient of d remains, of course, as long as sterilization occurs in any degree. In view of this possible bias, it is useful at this point to present an expression for the asymptotic bias of $\hat{\alpha}_1$, which can be derived without any constraint on e*. Let us assume--following P.J.K. Kouri and M. G. Porter (1974)--that the rate of domestic credit creation takes place according to:

$$(12) \quad d = \psi x + \beta r + v$$

where x can be interpreted as the portion of the rate of domestic credit creation not resulting from any sterilization process, v is an error term and β measures the degree of sterilization--a value of β equal to minus one implying complete sterilization and a value of β equal to zero implying no sterilization. If x, r and v, as well as

x, v and e*, x and u, and v and u are asymptotically uncorrelated, it can be shown--provided that d and $\dot{p}^*$ are independent--that the asymptotic bias of the OLS estimate of α_1 in equation (11) is given by the following expression:

$$(13)\quad \text{plim}\ (\hat{\alpha} - \alpha) = \frac{\beta(1-\beta\alpha)\sigma_u^2 + b}{\psi^2 S_x^2 + \sigma_v^2 + \sigma_u^2\beta^2 + c}$$

where: $b = \beta(1-\beta\alpha)(\alpha_2 S_{pe} - S_e^2 - S_{re}(1-\beta\alpha))$

$$c = -\beta^2(S_e^2 - \alpha_2 S_{pe} + 2S_{re}(1-\beta\alpha))$$

and σ_u^2, σ_v^2, S_x^2, S_e^2 are respectively the variances of u and v and the asymptotic variances of x and e*, and S_{pe}, and S_{re}, are the asymptotic covariances between $\dot{p}^*$ and e*, and between r and e*. For simplification of the notation we dropped the subscript one from α_1.

Notice that for a constant rate of devaluation--from which a fixed exchange rate is a particular case--, S_e^2, S_{pe} and S_{re} are all equal to zero so that the expression collapses to:

$$(14)\ \text{plim}\ (\hat{\alpha}-\alpha) = \frac{\beta(1-\beta\alpha)\sigma_u^2}{\psi^2 S_x^2 + \sigma_v^2 + \sigma_u^2\beta^2}$$

which is the formula reported by Kouri and Porter.

The model suggests that the sum $S_e^2 + S_{re}$ has to be in the neighborhood of zero. Taking into accoung that $(1-\beta\alpha)$ is a positive number--a requirement for stabilization, as Kouri and Porter claim--one finds that the bias in (14) is always negative, indicating that under a constant rate of devaluation the estimated coefficient of d is biased upwards in absolute value as long as some degree of sterilization does

occur. The bias in (13), however, can be positive, negative or null for any β, so that application of equation (11)--for periods of variable percent changes in the exchange rate--appears to be less vulnerable to the occurrence of sterilization. In other words, the bias in (13)--despite the impossibility of determining its direction--appears to be less relevant than that expressed by (14).

In the Chapter that follows we present the empirical results of the application of equation (11) to the Brazilian case.

Notes

[1]Here we are following Girton and Roper by assuming that U.S. monetary conditions are good proxy for the world monetary conditions.

[2]Defined as currency held by the public plus demand deposits.

[3]Considering that for any variable x, its discrete change Δx is a good approximation to dx/dt.

[4]Notice that only the relative version of purchasing power parity is required, so that equation (2) is a sufficient condition but not necessary.

CHAPTER V

EMPIRICAL RESULTS

The regression equation (11) presented in the preceding chapter was estimated for the periods 1955-1975 and 1962-1975 using annual data and the Cochrane-Orcutt iterative technique to adjust for serial correlation.[1] The percent change in the U.S. wholesale price index--drawn from the International Financial Statistics of the International Monetary Fund and reported in Table 14--was used as the foreign inflation rate. The change in net foreign assets or the balance of payments as a proportion of the money supply (r) was obtained by multiplying the average exchange rate by the balance of payments in U.S. dollars and dividing by the money supply of the previous year.[2] The corresponding data are reported in Tables 1, 5, 6, and 13. The rate of expansion of domestic credit was obtained simply by subtracting the balance of payments as a proportion of the money supply (r) from the rate of expansion of the money supply. The latter, in turn, was obtained by dividing its correspondent increase--stock in the current year minus stock in the previous year--by its stock in the preceding year.[3] That is, $(M_t - M_{t-1})/M_{t-1}$.

The choice of the two periods was based on the fact that 1954 and 1961, especially the latter, marked the beginnings of new phases of the exchange rate policy in Brazil, each making the economy more open.

As we saw in Chapter II, prior to 1954 Brazil experienced a system of direct exchange controls to such an extent that application of the present model prior to that year would be inconsistent with the open economy assumption presented in Chapter IV.

The results for 1955-1975 reported by equation (1) in Table 7 indicate that the model fits reasonably well. The F-statistic-equal to 17.68--suggests that the overall estimated equation does have a significant role in explaining the "exchange market pressure" ($r + e^*$) at a 1 percent confidence level. The coefficient of determination--equal to 0.68--indicates a fairly high degree of explanatory power with respect to variations in this composite variable.

Even more encouraging is the fact that, at a 5 percent confidence level, one can not reject the hypothesis that the coefficients of the rate of expansion of domestic credit and of the United States dollar inflation rate do conform with those predicted by the model. That is, α_1, equals minus unity and α_2 equals unity. However, the t-value--equal to 1.321--of the estimated coefficient of U.S. dollar inflation rate does not permit rejection of the null hypothesis that it equals zero at the same confidence level. These conclusions can be drawn directly from Table 8 which reports 95 percent confidence intervals for the estimated coefficients.

The results for the 1962-1975 period, reported by equation (3) in Table 7, conform to the predictions of the model. The 95 percent confidence intervals for the estimated coefficients, reported in Table 8, indicate that at the 5 percent significance level we would not reject the hypotheses that the coefficients of the rate of expansion of domestic credit and of the United Stated dollar inflation rate

Table 7

REGRESSION RESULTS FOR EQUATION (11) OF CHAPTER IV AND VARIATIONS

No.	Period	Dependent Variable	Estimated Coefficients of the Independent Variables				R^2	D.W.	SSR
			Intercept	d	$\dot{p}$*	k	F	Rho	SER
1	55/75	r + e*	0.138	-1.125	1.322		0.68	2.25	0.81
			(1.258)	(-5.406)	(1.312)		17.68	-0.10	0.22
2	55/73	r + e*	0.075	-1.028	2.588		0.69	2.23	0.78
			(0.502)	(-3.918)	(1.187)		16.33	-0.10	0.23
3	62/75	r + e*	0.177	-1.195	1.247		0.92	2.11	0.11
			(3.088)	(-11.429)	(2.594)		57.30	-0.27	0.10
4	62/73	r + e*	0.098	-1.080	2.650		0.94	2.13	0.09
			(1.183)	(-8.053)	2.322		60.37	-0.25	0.10
5	62/75	r + e*	0.158	-1.197	1.273	0.013	0.92	2.12	0.11
			(0.978)	(-10.648)	(2.337)	(0.127)	34.45	-0.27	0.11
6	62/75	r	0.241	-0.403	-0.429		0.48	1.56	0.14
			(2.736)	(-2.425)	(-0.580)		4.67	0.28	0.12

Note: The Cochrane-Orcutt iterative technique was used to adjust for serial correlation. The numbers in parentheses below the estimated coefficients indicate t-values. R^2 = coefficient of determination, F = F-statistic, D.W. = Durbin-Watson statistic, SSR = sum of squared residuals and SER = standard error of the regression. Rho is the estimated coefficient of first-order serial correlation. Other symbols are defined in the text.

equal minus unity and unity respectively. The relevance of such results is enhanced by the fact that one would not accept the null hypothesis that any of these estimated coefficients is equal to zero at the referred confidence level.

Table 8

NINETY-FIVE PERCENT CONFIDENCE INTERVALS FOR THE ESTIMATED COEFFICIENTS

Equation No and Period	Coefficients		
	α_0	α_1	α_2
1. 55/75	(-0.09, 0.37)	(-1.56, -0.69)	(-0.80, 3.45)
2. 55/73	(-0.25, 0.40)	(-1.59, -0.47)	(-2.06, 7.24)
3. 62/75	(0.05, 0.30)	(-1.43, -0.96)	(0.18, 2.32)
4. 62/73	(-0.09, 0.29)	(-1.39, -0.77)	(0.02, 5.28)

Note: From the first to the fourth equation the relevant t-values are respectively 2.100. 2.131, 2.228 and 2.306. Table 7 provides other figures required to calculate the intervals.

In addition, the overall equation is highly significant in explaining the Brazilian "exchange market pressure"--considering that the F-statistic equals 57.30--and presents a high degree of explanatory power, the coefficient of determination being 0.92.

The implications for the Brazilian external imbalance of these coefficients being statistically equal to minus one and to one respectively follow directly from the model. In fact, based on the constant term of equation (3) in Table 7, the relevant relationship between the "exchange market pressure" ($r + e^*$) and the rate of expansion of domestic

credit (d) and the U.S. dollar inflation rate ($\dot{p}^*$), may be expressed by:

$$r + e^* = 0.18 - d + \dot{p}^*$$

Suppose the rate of foreign inflation ($\dot{p}^*$) is set at the 7 percent level for a given year. In this case, according to the equation above, the model predicts that any rate of domestic credit creation as a proportion of the money supply exceeding 0.25 or 25 percent will create an adverse "exchange market pressure." If the increase in domestically created money as a proportion of the money supply reaches the rate of 50 percent, for example, the country should be prepared either to lose foreign reserves equivalent to 25 percent of its money supply, to devalue the cruzeiro by 25 percent or to experience some combination of reserve loss and devaluation.

A striking finding in view of the considerable explanatory power of the model for the Brazilian case considering the 1962-1975 period is that the model seems, to a great extent, to be able to absorb effects such as the four-fold rise in oil price in the last two years of the period.[4]

To confirm this we ran equation (11) for the 1955-1973 and 1962-1973 periods. The results are reported by equations (2) and (4) respectively, in Table 7.

As can be seen, the overall results are not significantly different from those obtained for the 1955-1975 and 1962-1975 periods. Regarding particularly to the coefficients of determination, the small increases from 0.68 to 0.69 and from 0.92 to 0.94 do not disconfirm the explanatory power of the model during the oil crisis period in a

statistical sense. Figure 4 showing actual and predicted values of the Brazilian "exchange market pressure" for the 1962-1975 period confirms this.

Two main reasons could explain why the model loses explanatory power when equation (11) is run for the 1955-1975 period as opposed to 1962-1975. One is that from 1955 to 1961 the Brazilian economy was less open than afterwards. During that period a highly protectionist policy of import substitution was followed. The other is that perhaps the reported import exchange rates do not reflect the true effective rates. As we noted in Chapter II, during that period there prevailed such a complex system of multiple rates in Brazil that one can hardly figure out an appropriate measure of the effective exchange rate.

As we saw in Chapter IV, the model we are testing using regresssion equation (11) assumes that the "exchange market pressure" is independent of the way the monetary authorities are trying to absorb it. To test the validity of this prediction we used the variable k, as defined below, as an additional regressor.

$$k = (e^* - 1)/(r - 1)$$

Despite its strange appearance, k is a good measure of the way the monetary authorities are trying to absorb $r + e^*$. The more the monetary authorities devalue the domestic currency the greater will be k. The simple ratio e^*/r used by Girton and Roper does not have this required property since it is discontinuous for r equal to zero.[5]

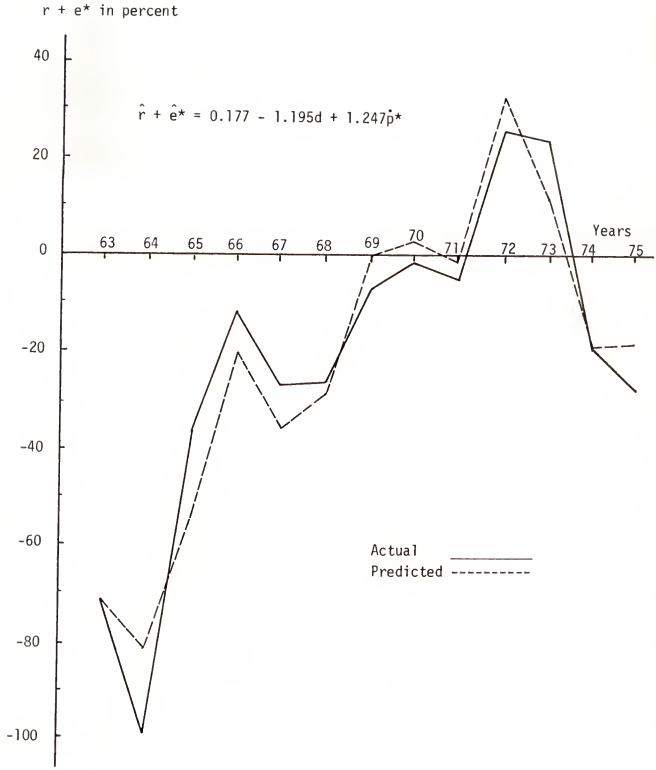

Figure 4

Explanation of the Brazilian "Exchange Market Pressure", 1963-1975.

Including k as an additional regressor in equation (11) we estimated the resulting equation for the 1962-1975 period. The results are reported by equation (5) in Table 7. As we can see, compared with equation (3)--except for the F-statistic and for the significance of the intercept--there were no relevant changes. The inclusion of k brought no improvement to the coefficient of determination nor statistical change in the estimated coefficients of the rate of expansion of domestic credit (d) and of the U.S. dollar inflation rate ($\dot{p}^*$). Considering this and the very low t-value of its estimated coefficient we have no basis for accepting the hypothesis that the value $r + e^*$ depends on the way the government absorbs it. So once more the empirical results confirm the model's predictions and its excellent fit to the Brazilian data for the 1962-1975 period.

In his application of Girton and Roper's model to Canada, Australia, Germany, Japan and the United Kingdom, Sargen (1975) found out that Girton and Roper's regression equation consistently did a poorer job of explaining periods marked by large movements of the exchange rate. As an explanation of this phenomenon he raised the possibility that the regression equation could in fact be explaining the balance of payments as a proportion of the money supply (r) rather than the composite variable $r + e^*$. To test this proposition he re-estimated the original equations substituting r for $r + e^*$ as the dependent variable. Except for Canada the results did show a better overall fit with r as the dependent variable.

Could this be happening in the Brazilian case? Certainly not. Even though the 1962-1975 period had been marked for relevant movements of the exchange rate, the results show that the regression equation (11) has a great ability to explain variations in "exchange market pressure." The R-squared, equal to 0.92, is already high. So how could the equation be explaining the proportional balance of payments (r) alone instead of the composite variable r + e*?

To confirm this position we followed Sargen's procedure and re-estimated regression equation (11) with r as the dependent variable instead of r + e*.

The results reported by equation (6) in Table 7 indicate that Sargen's proposition is not valid for the Brazilian case. The coefficient of determination--equal to 0.48--is low. In addition the F-statistic is not high enough to confirm the hypothesis that the overall equation is significative at the 1 percent confidence level. Thus, in short, taking into account this latter test as well as the preceding ones, we conclude:

a) The model presented in Chapter IV does a very good job of explaining the Brazilian "exchange market pressure"--the balance of payments as a proportion of the money supply minus the percent change in the exchange rate--considering primarily the 1962-1975 period;

b) The Brazilian "exchange market pressure" does not depend on the way the government is conducting its exchange rate policy i.e., if devaluing more or less;

c) The explanatory power of the model does not depend on the relationship between international reserve changes and changes in domestic assets.

The implications of the validity of such conclusions for the interpretation of the Brazilian external imbalance have already been discussed. The model predicts that given the foreign inflation rate, the rate of expansion of domestic credit will determine the "exchange market pressure." Beyond a certain rate of expansion of domestically created money there will be, with great likelihood, an adverse "exchange market pressure" which will entail devaluation of the cruzeiro in the same proportion if the country is not willing to lose foreign reserves.

This model that we presented and tested is not new. In fact it is a version of Girton and Roper's model. Its merit lies in the fact that it is simpler and easier to use for empirical studies of economies embracing the characteristics of the so-called small country.

Notes

[1]The samples were not extended to 1976 because data on the Brazilian balance of payments were unavailable for that year.

[2]Brazil reports the net change in foreign assets of both monetary authorities and commercial banks as the balance of payments. See for instance, Relatonio Anual do Banco Central do Brasil, 1975, pp. 198-199.

[3]The stocks refer to annual averages of the stocks of the last day of each month.

[4]The Brazilian monetary authorities claim that the substantial deficits in the balance of payments in 1974 and 1975 were due, in great extent, to the four-fold increase in oil price. In fact Brazil imports approximately 80 percent of its oil and in 1974 and 1975 oil accounted for 22.5 and 25.3 percent of all imports by value.

[5]Noting that r is less than one in absolute value, one may see that k is a decreasing fucntion of e* for any given r. Since e* is the negative value of the percent change of the exchange rate, the greater the rate of devaluation of the domestic currency the greater will be k. Also, as long as e* is less than one, or, differently, as long as appreciation of the domestic currency does not reach 100 percent, k is a decreasing function of r for a given e*.

Not presenting these properties, the ratio e*/r does not meet the necessary requirements for measuring the way r + e* is being abosrbed. To see clearly that e*/r is not an appropriate variable for the above purposes, let us consider the following observations:

No	e*	r	r + e*	e*/r	k
1	-0.6	0.3	-0.3	-2.0	2.28
2	-0.4	0.1	-0.3	-4.0	1.56
3	-0.2	-0.1	-0.3	2.0	1.09
4	-0.1	-0.2	-0.3	0.5	0.92

Notice that while the "exchange market pressure" is less absorbed by devaluation--which goes from 60 percent in observation 1 to 10 percent in observation 4--the ratio e*/r declines from the first to the second observation but--due to its discontinuity for r equal to zero--increases from the second to the third observation. The variable k however declines steadily when r + e* is less absorbed by devaluation.

APPENDIX

Table 9

MONEY SUPPLY. STOCKS ON THE LAST DAY OF EACH MONTH, 1946-1976. CR$ MILLIONS.

Months	Years							
	1946	1947	1948	1949	1950	1951	1952	1953
January	39.0	44.1	43.5	47.1	54.0	71.7	83.8	96.8
February	38.7	44.3	43.6	47.3	54.3	72.4	83.8	96.6
March	37.9	44.3	42.7	47.9	55.1	72.0	83.9	98.2
April	40.9	43.8	43.2	48.3	55.6	73.4	84.5	99.7
May	41.7	43.3	42.7	48.6	56.8	75.0	84.1	101.4
June	42.3	43.9	43.5	50.1	59.2	75.5	85.7	104.5
July	42.7	44.0	43.3	50.9	61.0	77.5	87.6	104.0
August	43.7	43.9	43.8	51.0	63.8	79.8	90.2	105.4
September	44.0	43.7	44.1	51.9	67.1	79.8	91.8	106.6
October	44.2	43.3	44.5	52.3	68.8	81.6	93.1	109.6
November	44.6	43.3	45.0	52.8	68.8	81.8	94.3	112.6
December	44.1	43.3	46.6	54.8	72.0	83.8	96.7	115.4

Table 9 - continued

Months	Years							
	1954	1955	1956	1957	1958	1959	1960	1961
January	117.5	141.9	167.3	202.1	272.0	336.6	472.7	656
February	119.5	143.3	170.3	204.9	277.9	335.3	484.1	685
March	119.9	145.1	173.5	207.5	283.8	343.7	492.2	709
April	122.4	147.0	176.7	210.9	291.2	350.5	499.6	720
May	122.1	148.1	181.4	214.7	293.9	355.2	509.8	723
June	123.8	151.7	184.4	218.4	300.1	365.8	521.9	739
July	126.4	151.9	186.5	222.1	303.5	379.9	527.5	760
August	132.5	155.2	186.9	225.6	307.6	500.3	544.2	801
September	135.6	159.4	189.7	234.9	317.4	415.6	573.3	820
October	139.3	162.2	191.6	244.6	318.8	429.0	592.2	868
November	139.0	163.1	195.0	253.0	324.1	445.4	614.1	904
December	142.7	166.1	202.4	267.4	328.8	469.8	651.9	994

Table 9 - continued

Months	Years							
	1961	1962	1964	1965	1966	1967	1968	1969
January	1000	1621	2675	4886	8396	9828	14274	20013
February	1024	1638	2754	5137	8429	10068	14672	20278
March	1028	1638	2911	5295	8324	10387	15617	21155
April	1062	1641	2975	5544	8369	10961	16332	21410
May	1091	1713	3158	5822	8521	11506	16559	21698
June	1138	1804	3460	6316	8847	12506	16941	22473
July	1189	1850	3536	6603	8740	12347	16950	22220
August	1258	1962	3767	7007	8963	12830	17524	22865
September	1318	2076	3967	7370	9072	13175	18214	23586
October	1383	2173	4214	7742	9187	13424	18599	23855
November	1440	2321	4435	7927	9305	14046	19176	24888
December	1631	2685	4875	8750	9959	14513	20174	26735

Table 9 - continued

Months	Years						
	1970	1971	1972	1973	1974	1975	1976
January	25786	32791	42584	58386	86901	112097	161338
February	26047	33122	43190	60524	90813	112100	163895
March	26753	33374	45292	62342	93857	116573	165953
April	27351	34315	45977	65655	95010	118998	170145
May	28345	35419	46920	68475	96636	125059	176776
June	29469	37799	49703	73672	100885	133144	192791
July	29417	38320	49260	73600	98683	132021	191647
August	29802	38827	49594	75365	103705	140884	191573
September	29950	40524	52110	79614	103574	143819	196521
October	30360	42114	53937	82045	106243	146000	205188
November	31732	43736	55721	85275	114027	157816	214135
December	33638	44514	61550	90490	120788	172433	236506

Source: Conjuntura Econômica, April 1977.

Table 10

EXCHANGE RATE FOR GENERAL IMPORTS. 1946-1959: Cr$/U.S.$. 1960-1968: NCr$/U.S.$

Months	Years								
	1946	47-52	1953	1954	1955	1956	1957	1958	1959
January	19.50	18.72	18.72	53.52	75.97	101.25	83.07	111.66	244.61
February	19.50	18.72	41.20	61.67	87.27	119.39	86.26	130.60	280.07
March	19.50	18.72	48.00	58.39	104.57	107.05	84.92	137.00	291.63
April	19.50	18.72	42.80	50.93	105.46	145.00	85.72	158.10	238.51
May	19.50	18.72	47.00	49.02	105.43	147.61	84.43	149.98	194.32
June	19.50	18.72	47.73	49.14	103.47	137.11	84.02	150.20	183.20
July	19.32	18.72	43.28	58.04	102.90	114.79	88.54	156.14	182.23
August	18.86	18.72	36.67	65.10	109.93	105.61	108.39	169.38	177.13
September	18.72	18.72	38.55	63.17	97.24	99.81	89.42	209.66	216.42
October	18.72	18.72	47.51	67.31	100.11	91.68	83.02	204.78	221.62
November	18.72	18.72	52.72	91.82	99.62	88.08	79.42	198.98	212.24
December	18.72	18.72	47.71	79.80	90.92	86.30	86.32	209.57	209.06
Average	19.72	18.72	42.91	67.37	98.58	111.97	87.04	165.50	220.92

Table 10 - continued

Months	Years								
	1960	1961	1962	1963	1964	1965	1966	1967	1968
January	0.209	0.229	0.318	0.475	0.884	1.850	2.216	2.220	3.210
February	0.214	- -	0.318	0.508	0.896	1.851	2.219	2.591	3.210
March	0.244	0.271	0.318	0.531	0.900	1.846	2.220	2.715	3.210
April	0.242	0.284	0.318	0.558	0.910	1.840	2.220	2.715	3.210
May	0.238	0.270	0.335	0.620	1.124	1.840	2.220	2.715	3.224
June	0.232	0.261	0.362	0.630	1.200	1.840	2.220	2.715	3.225
July	0.229	0.263	0.367	0.643	1.200	1.840	2.220	2.715	3.220
August	0.228	0.270	0.407	0.667	1.234	1.840	2.220	2.715	3.330
September	0.229	0.294	0.480	0.708	1.589	1.845	2.220	2.715	3.662
October	0.229	0.298	0.475	0.679	1.610	1.845	2.220	2.715	3.700
November	0.229	0.314	0.475	0.653	1.610	2.061	2.220	2.715	3.728
December	0.229	0.317	0.475	0.730	1.656	2.213	2.220	2.715	3.815
Average	0.229	0.279	0.387	0.617	1.234	1.893	2.220	2.663	3.395

Sources: Till August 1963: Conjunctura Ecônomica in issues of September 1963 and October 1968. From September to December of 1968: average selling rates of the Central Bank of Brazil according to Table 12. Notes reported by Conjuntura Ecônomica in the issues of September 1963 and October 1968: a) The yearly averages are simple averages of the monthly averages; b) January 1946 to January 1953: free market with rate fixed by the government later called the "official market." Source: "International Financial Statistics" of the International Monetary Fund; c) February 1953 to May 1953: Rio de Janeiro free market rates. Source: Monthly statistics of the Servico de Estatistica Ecônomica e Financeira (SEEF) of the Finance Ministry; d) October 1953 to August 1957: weighted averages of the premia of the 5 Rio de Janeiro categories, plus the official rate in force. Source: Conjuntura Ecônomica; e) September 1957 to January 1961: weighted averages of the premia in the general category, Rio de Janeiro, plus the official rate in effect. Source: Conjuntura Ecônomica. The figure for December 1960 is for the whole country; f) February 1961: there were no auctions nor the corresponding rates; g) March 1961 to August 1963: Average of daily quotations in the so-called free market (other banks). Source: Conjuntura Ecônomica; h) To quotations from January 1962 to January 1963 must be added the value of the eventual "puppet." The "puppet" is included in later quotations, having disappeared on February 19, 1964.

Table 11

FREE EXCHANGE RATE USED ON PRIVATE FINANCIAL TRANSFERS
1946-1959: Cr$/U.S.$ 1960-1967: NCr$U.S.$

Months	Years						
	1946	1947	1948	1949	1950	1951	1952
January	20.00	- -	23.15	26.50	30.15	31.00	31.25
February	20.00	- -	23.30	27.50	33.00	29.25	32.50
March	- -	- -	25.00	28.75	32.45	32.50	34.00
April	- -	- -	25.25	28.50	32.70	32.50	34.00
May	- -	- -	26.50	29.00	33.50	32.40	34.25
June	- -	- -	27.00	30.50	33.25	30.00	33.30
July	- -	- -	27.50	31.00	30.70	29.00	33.50
August	- -	- -	32.00	30.25	21.65	28.80	33.00
September	- -	23.00	31.00	31.25	32.25	29.50	34.00
October	- -	22.50	30.50	32.50	33.15	28.00	37.50
November	- -	23.00	28.00	27.00	33.80	29.20	37.00
December	- -	23.25	26.55	30.75	32.00	30.00	36.50
Average	20.00	22.94	27.15	29.46	32.39	30.18	34.30

Table 11 - continued

Months	Years						
	1953	1954	1955	1956	1957	1958	1959
January	38.30	55.00	75.30	72.50	65.70	98.00	146.50
February	41.20	60.00	77.80	71.50	66.50	99.50	141.50
March	48.00	58.30	82.80	74.30	66.50	109.00	141.00
April	42.80	53.50	81.00	80.50	70.00	124.50	139.00
May	47.00	57.00	81.30	84.00	74.20	125.50	133.00
June	44.50	59.50	77.00	83.50	72.00	134.50	149.50
July	42.50	62.50	73.00	77.50	74.50	135.50	154.50
August	39.50	63.00	70.00	74.20	79.50	168.00	155.50
September	38.80	63.50	69.00	69.50	83.00	158.00	167.00
October	47.00	66.50	67.20	68.20	87.30	174.50	186.00
November	53.00	74.40	66.80	67.50	91.50	140.40	198.00
December	56.50	76.50	67.50	66.50	91.00	141.50	203.00
Average	44.93	62.52	74.06	74.14	76.81	131.83	159.54

Table 11 - continued

Months	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
January	0.186	0.230	0.367	0.760	1.380	1.840	2.215	2.210
February	0.186	0.221	0.378	0.685	1.405	1.885	2.220	2.715
March	0.192	0.277	0.358	0.640	1.880	1.833	2.220	2.715
April	0.189	0.283	0.353	0.710	1.220	1.870	2.215	2.720
May	0.186	0.265	0.398	0.750	1.285	1.865	2.210	2.720
June	0.188	0.262	0.345	0.794	1.291	1.860	2.210	2.715
July	0.186	2.261	0.493	0.850	1.385	1.860	2.210	2.725
August	0.187	0.298	0.650	1.210	1.665	1.865	2.210	3.250
September	0.192	0.297	0.675	1.090	1.771	1.865	2.210	3.150
October	0.192	0.345	0.642	1.210	1.676	1.865	2.210	3.120
November	0.195	0.358	0.732	1.135	1.645	2.215	2.210	3.130
December	0.206	0.390	0.795	1.189	1.830	2.220	2.210	3.150
Average	0.190	0.291	0.523	0.903	1.536	1.920	2.213	2.860

Source: Conjuntura Econômica in issues of September 1963 and October 1968. Notes reported in the same issues of Conjuntura Econômica: a) Rates on the last day of each month. The yearly averages are simple monthly averages; b) The averages for 1946 and 1947 relate only to months in which rates were quoted; 3) January and February of 1946: Special free market rate. Source: International Financial Statistics; d) March 1946 to August 1947: black market. Rates now unknown; e) September 1947 to January 1953: Source: IFS, under the name of "curb rate"; f) February 1953 to September 1961: free market. Source: Superintendency of Money and Credit (SUMOC); g) October 1961 to December 1967: parallel market. Source: Conjuntura Econômica.

Table 12

EVOLUTION OF THE EXCHANGE RATE (NCr$/U.S.$), 1968-1976

New Rating Date		Purchase	Sale	Period (days)	% change in period
1968 - January	4	3.200	3.220		
August	27	3.630	3.650	326	13.35
September	24	3.675	3 700	28	1.37
November	19	3.745	3.770	56	1.89
December	9	3.805	3.830	20	1.59
1969 - February	4	3.905	3.930	57	2.61
March	19	3.975	4.000	43	1.78
May	13	4.025	4.050	55	1.25
July	7	4.075	4.100	55	1.23
August	27	4.125	4.150	51	1.22
October	3	4.185	4.210	37	1.45
November	14	4.265	4.290	42	1.90
December	18	4.325	4.350	34	1.40
1970 - February	4	4.380	4.410	48	1.38
March	30	4.460	4.490	54	1.81
May	18	4.530	4.560	49	1.56
July	10	4.590	4.620	53	1.32
	24	4.620	4.650	14	0.65
September	18	4.690	4.720	56	1.51
November	4	4.780	4.810	47	1.91
	18	4.830	4.860	14	1.04
December	22	4.920	4.950	34	1.85
1971 - February	9	5.000	5.030	49	1.62
March	22	5.080	5.110	41	1.59
May	3	5.160	5.195	42	1.66
June	11	5.250	5.285	38	1.73
August	5	5.370	5.405	54	2.27
September	13	5.470	5.505	39	1.85
November	10	5.600	5.635	57	2.36
1972 - January	28	5.750	5.785	80	2.66
March	16	5.810	5.845	47	1.04
May	8	5.880	5.915	53	1.20
July	14	5.930	5.965	68	0.85
September	5	5.990	6.025	53	1.01
October	17	6.060	6.095	42	1.16
November	15	6.180	6.215	23	0.81

Table 12 - continued

New Rating Date		Purchase	Sale	Period (days)	% change in period
1973 - February	14	5.995	6.030	61	-2.98
April	24	6.060	6.100	69	1.16
July	9	6.090	6.130	76	0.49
September	20	6.120	6.160	73	0.49
December	14	6.180	6.220	84	0.97
1974 - January	31	6.300	6.340	48	1.92
February	20	6.415	6.455	20	1.81
April	16	6.515	6.555	55	1.55
June	5	6.640	6.680	50	1.91
June	25	6.775	6.815	20	2.02
July	9	6.845	6.885	14	1.03
August	15	6.980	7.020	36	1.96
September	18	7.090	7.130	34	1.57
October	28	7.180	7.220	40	1.26
November	19	7.285	7.325	22	1.45
December	19	7.395	7.435	31	1.50
1975 - January	28	7.510	7.550	40	1.55
February	20	7.580	7.580	23	0.93
March	19	7.695	7.735	27	1.51
April	11	7.805	7.845	23	1.42
May	14	7.925	7.975	33	1.66
June	26	8.020	8.070	43	1.19
July	8	8.080	8.130	12	0.74
August	5	8.235	8.285	28	1.91
	25	8.310	8.360	20	0.91
September	23	8.470	8.520	29	1.91
October	27	8.620	8.670	34	1.76
November	12	8.725	8.775	16	1.21
	25	8.850	8.900	13	1.42
December	16	9.020	9.070	21	1.91
1976 - January	21	9.195	9.245	36	1.93
February	17	9.370	9.420	27	1.89
March	9	9.550	9.600	20	1.91
	30	9.885	9.935	21	3.49
April	13	10.220	10.270	14	3.37
	30	10.315	10.365	17	0.92
May	24	10.500	10.550	24	1.78
June	8	10.600	10.650	15	0.95
	23	10.730	10.800	15	1.41

Table 12 - continued

New Rating Date		Purchase	Sale	Period (days)	% change in period
1976 - July	23	10.885	10.955	30	1.44
August	18	11.100	11.170	26	1.96
September	10	11.300	11.370	23	1.79
October	12	11.550	11.620	32	2.20
	28	11.760	11.830	16	1.81
November	25	11.985	12.055	28	1.90
December	22	12.275	12.345	27	2.41

Source: Central Bank of Brazil

Table 13

SUMMARY OF THE BALANCE OF PAYMENTS IN US$ MILLIONS
1947-1975

Years	Current Transactions 1	Net Capital Flow 2	Net Errors and Omissions 3	Surplus (+) Deficit (-) 4=1+2+3
1947	-151	12	-43	-182
1948	2	-51	29	-24
1949	-82	-74	82	-74
1950	140	-65	-23	52
1951	-403	-11	123	-291
1952	-624	35	-26	-615
1953	55	59	-98	16
1954	-195	-18	10	-203
1955	2	3	12	17
1956	57	151	-14	194
1957	-264	255	-171	-180
1958	-248	184	-189	-253
1959	-311	182	-25	-154
1960	-478	58	10	-410
1961	-222	288	49	115
1962	-389	181	-138	-346
1963	-114	-54	-76	-244
1964	140	82	-281	4
1965	368	-6	-31	331
1966	54	124	-25	153
1967	-237	27	-35	-245
1968	-508	541	-1	32
1969	-281	871	-41	549
1970	-562	1015	92	545
1971	-1307	1846	-9	530
1972	-1489	3492	436	2439
1973	-1688	3512	355	2179
1974	-7122	6254	-68	-936
1975	-6751	5913	-112	-950

Sources: From 1947 to 1970, Boletim do Banco Central do Brasil of December, 1972. From 1971 to 1973, issues of April, 1973, June, 1973 and December, 1974 of the same Boletim. 1974 and 1975, Relatório Anual do Banco Central do Brasil, 1975.

Table 14

WHOLESALE PRICE INDEXES - BRAZIL AND THE UNITED STATES, 1946-1976

Years	Brazil 1965/67=100		U.S.A. 1970=100		Differential (1)-(2)
	Index	Percent change (1)	Index	Percent change (2)	
1946	.788	-	56.3	-	-
1947	.858	8.9	69.0	22.6	-13.7
1948	.917	6.9	75.0	8.7	-1.8
1949	.959	4.6	71.3	-4.9	9.5
1950	.983	2.5	74.3	4.2	-1.7
1951	1.19	21.1	82.5	11.0	10.1
1952	1.34	12.6	80.3	-2.7	15.3
1953	1.55	15.7	79.2	-1.4	17.1
1954	1.93	24.5	79.3	0.1	24.4
1955	2.31	19.7	79.5	0.3	19.4
1956	2.81	21.6	82.2	3.4	18.2
1957	3.23	14.9	84.5	2.8	12.1
1958	3.69	14.2	85.7	1.4	12.8
1959	5.27	42.8	85.9	0.2	42.6
1960	6.92	31.3	86.0	0.1	31.2
1961	9.72	40.5	85.7	-0.3	40.8
1962	14.6	50.2	85.9	0.2	50.0
1963	25.7	76.0	85.6	-0.3	76.3
1964	46.6	81.3	85.8	0.2	81.1
1965	71.6	53.6	87.5	2.0	51.6
1966	101	41.1	90.4	3.3	37.8
1967	128	26.7	90.6	0.2	26.5
1968	157	22.7	92.8	2.4	20.3
1969	187	19.1	96.5	4.0	15.1
1970	223	19.3	100.0	3.6	15.7
1971	271	21.5	103.3	3.3	18.2
1972	319	17.7	107.9	4.4	13.3
1973	368	15.4	122.0	13.1	2.3
1974	475	29.1	145.0	18.9	10.2
1975	607	27.8	158.4	9.2	18.6
1976	852	40.4	165.7	4.6	35.8

Sources: U.S.A.: International Financial Statistics of the International Monetary Fund. Brazil: Conjuntura Econômica of April 1977.

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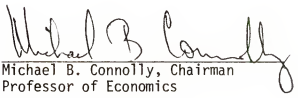
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.



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Professor of Economics

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December 1977

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